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CANADIAN

ELECTRICAL NEWS

—AND—

Engineering Journal

VOL. XIII.

1903:
THE C. H. MORTIMER PUBLISHING COMPANY OF TORONTO, LIMITED.
TORONTO, CANADA.

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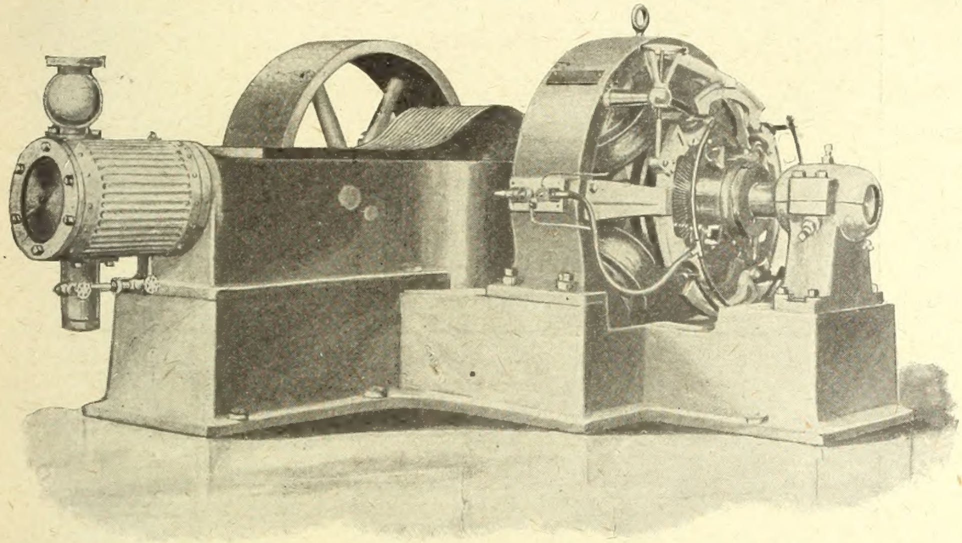

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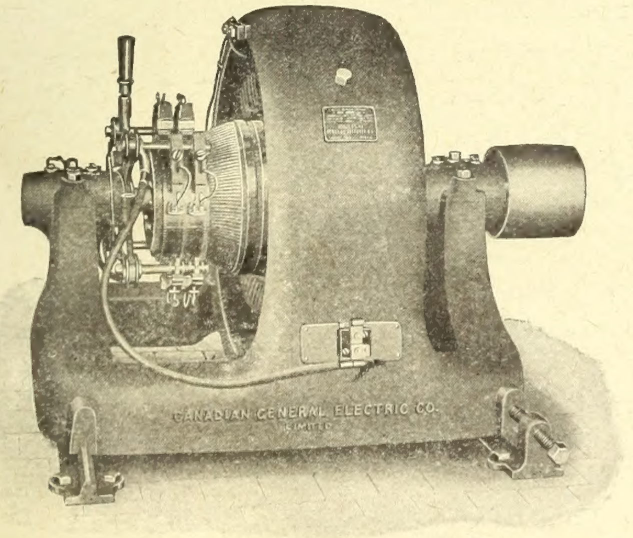

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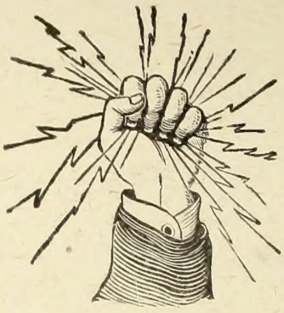

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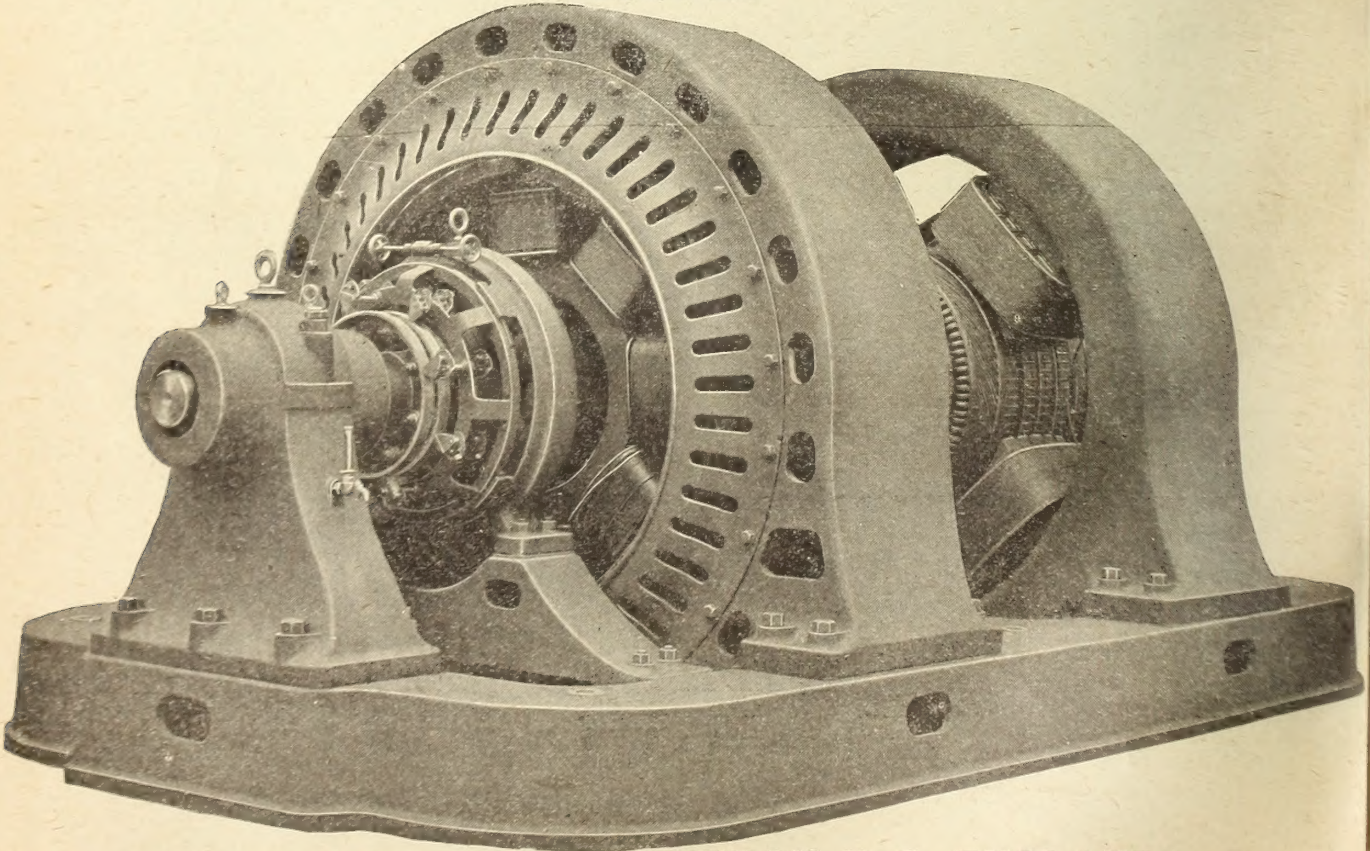

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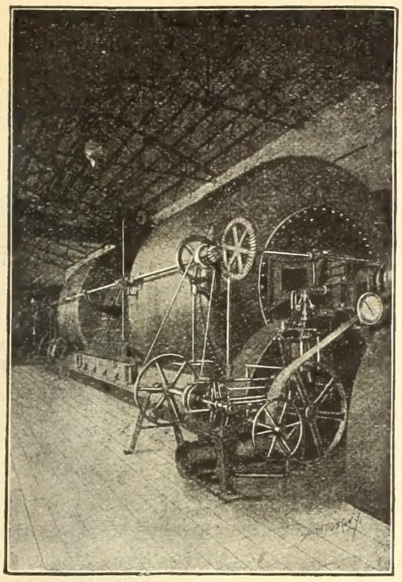

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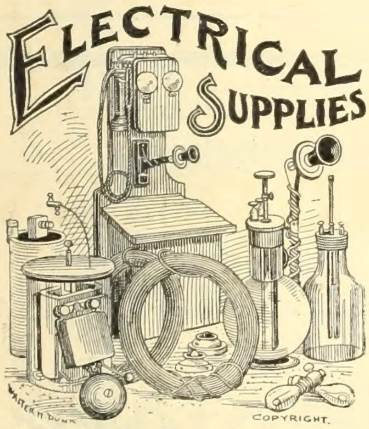

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TRADE NOTES.

Attention is directed to the new advertisement in this issue of the Western Telephone Manufacturing Co., of Chicago, who will be pleased to quote on any kind of telephone apparatus.

Catalogue No. 19 of the Penberthy Injector Company, Windsor, Ont., is one which should be in the hands of all steam users. In it are presented two new specialties, the low and high water alarm and the force feed lubricator.

Mr. P. E. Derst has purchased the business and patents of the Cyclone Grate Bar Company and has opened offices at 19 Yonge Street Arcade, Toronto, under the style of P. E. Derst & Co. They will handle other steam specialties as well.

Messrs. John Starr, Son & Company, of Halifax, N.S., recently installed an electric light plant of 300 lights, also a private telephone plant and electric watchman's detector system for the Sissiboo Pulp & Paper Company, Sissiboo Falls, N. S.

We wish to draw attention to the advertisement of the Canada Metal Company of Toronto, which appears in this issue. This company now manufacture battery zincs, fuse wire, etc. There has been considerable demand for these, the trade in Canada being a particularly good one.

The Pelton Water Wheel Company reports having just closed a contract with the Vancouver Power Company, of Vancouver, B.C., covering three Pelton wheel units with a combined capacity of 10,000 horse power. The wheels are for direct connection to electric generators; the power to be used for electric railway and manufacturing purposes.

The largest and most modern equipped pattern shop in the Dominion is the Downer Pattern Works, of Toronto, whose advertisement appears in this issue. They make to order patterns and models, in wood or metal, for engines, pumps, heating apparatus, electrical work and machines of every description. Under the able management of Mr. J. M. Downer this concern have made great strides in recent years and we predict a brilliant future.

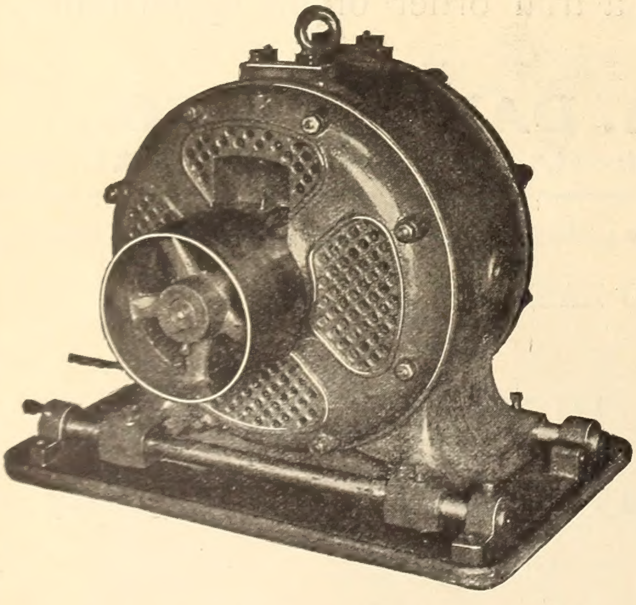
The National Carbon Company, of Cleveland, Ohio, have favored us with a beautiful calendar for 1903 containing a picture of their "Twentieth Century Columbia." The original picture "Miss Columbia" was painted by Mr. G. M. Kaver, probably the greatest painter of juvenile faces and figures in America. It is intended as a reminder of the excellent quality of the Columbia carbons.

The Dominion Belting Company, Limited, has recently been organized in Hamilton and have commenced the erection of a new factory on Sherman Avenue, to be of brick, 155x55 feet. It will be equipped with the latest and best machinery for the manufacture of stitched and oiled cotton duck belting. The company have engaged as superintendent one of the most experienced men in the United States in that line of business. Mr. John J. McGill, formerly manager of the Canadian Rubber Company, of Montreal, is president of the company. Mr. C. T. Granthan, of Hamilton, is also interested.

Messrs. H. G. Aylwin, J.E. Campbell, J.M. Toombs and H.E. Robinson, of Carman, and E.S. Harrison, of Winnipeg, have been incorporated as the Carman Electric Light & Power Company, Limited, with a capital of $50,000.

The Sturgeon Falls Pulp Company, of Sturgeon Falls, Ont., propose to operate their large paper mill by alternating-current induction motors throughout. Two Westinghouse type "F" motors are to be used to drive the variable speed shaft of the paper machines, and two 75 horse-power, type "C" motors will drive the constant speed line shaft of the same machines. Another 75 horse-power, type "C" motor will operate other machinery in the mill. A 15 horse-power induction motor will be direct connected to a triplex pump; one of 10 horse-power will drive the wet machines; a 20 horse-power motor will drive the agitators for the clay-mixing tanks and a 30 horse-power motor will drive the conveyors. The contract has been placed with the Westinghouse Electric & Mfg. Company and includes also a 560 kilowatt, revolving field alternator, designed to be direct connected to a water-wheel, with the exciter, switchboard and instruments to accompany the generator. The engineer and designer of the Sturgeon Falls plant is Mr. George F. Hardy.

Ampere——



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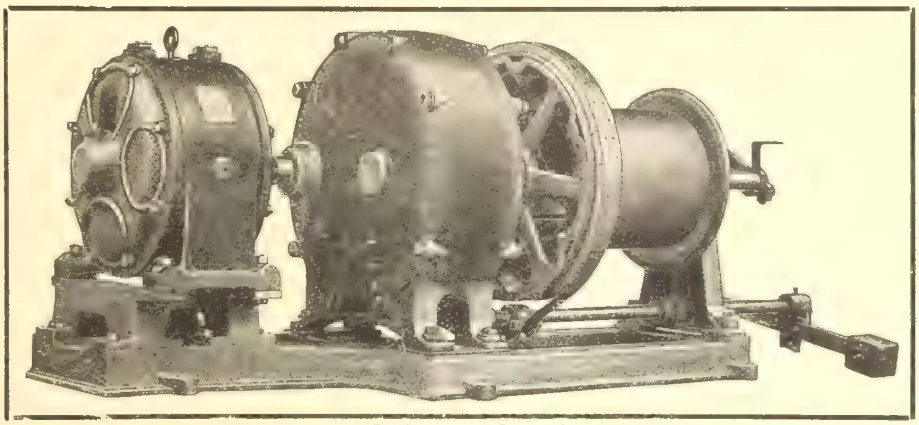

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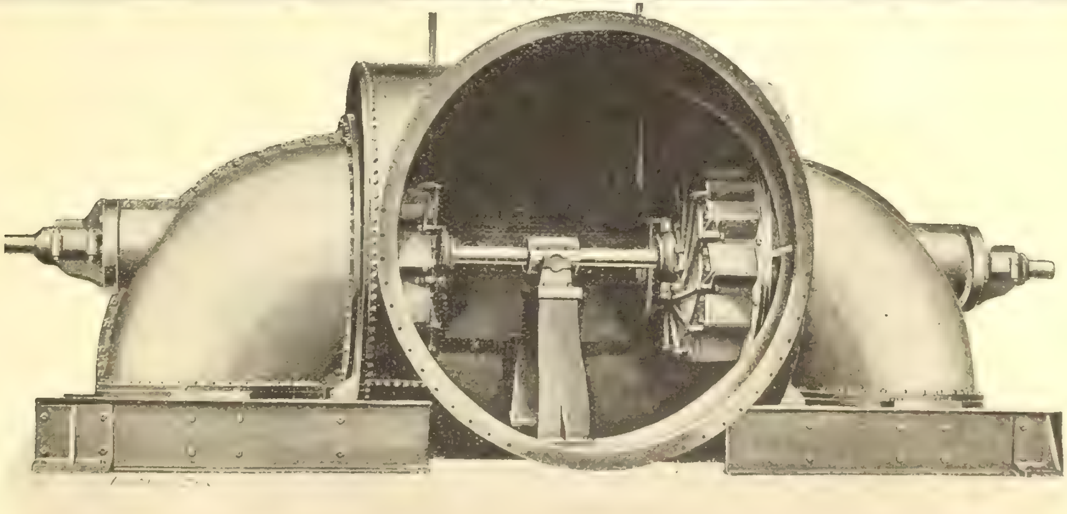

The above plate shows a pair of 35 inch Crocker Turbines, in horizontal setting, outward discharge type. This arrangement can be placed in any part of the line of shafting, when circumstances permit of direct connection, power being taken off on both sides of the case if desired. We have designs for many other styles of setting. Estimates and catalogue promptly forwarded to those applying and stating conditions under which power is to be developed.

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CANADA.

PERSONALS.

Mr. James Bannon, chief engineer of the City Hall, Toronto, was on Christmas Eve presented with a gold mounted umbrella by the staff of the engine room.

Mr. Wm. Pullman, formerly with the Sturgeon Falls Electric Light & Power Co., Sturgeon Falls, Ont., has accepted the position of superintendent of the Vernon, B. C., electric light plant.

Mr. J. W. Moyes, manager of the Metropolitan Railway, North Toronto, who has been unwell for some time past, recently underwent a surgical operation, since which time he has been gradually improving.

Mr. G. H. B. Hooper, who died in Toronto recently, was well known as an electrical inventor. One of his inventions widely and favorably known was the automatic electric brake, used successfully in many of the large cities.

Mr. Will A. Moore, an old Upper Canada College boy and champion athlete of 1893, spent Christmas week with his parents at Moore Park, Toronto. He is now electrical engineer with Fairbanks, Morse & Company, of Chicago.

Mr. A.M. Wickens, who was recently temporarily suspended as chief engineer of the Ontario Government buildingsshas been reinstated. A rearrangement of the work has been made and it is understood that Mr. Wickens will confine his attention entirely to the Parliament buildings.

Mr. J. Norman Smith, until recently manager at Toronto of Canadian Motors, Limited, has accepted a position of responsibility with the Lachine Rapids Hydraulic & Land Company, of Montreal. His many friends in the west wish him a large measure of success in the east.

Before leaving Toronto to assume charge of the plant of the Winnipeg Power & Light Company, Mr. J. S. Mackenzie was presented with a beautiful gold chain and locket. The presentation was made by Mr. J. M. Smith, comptroller of the Toronto Railway Company, on behalf of the staff. Mr. Mackenzie carries with him not only the best wishes of his colleagues, but also of a wide circle of personal friends.

Mr. O.W. Brain, electrical engineer to the Board of Railway Commissioners for New South Wales, is now in Canada inspecting the chief railway systems. Mr. Brain has visited the leading railway centres of Great Britain and the Continent with a view to gathering the latest information in regard to new electrical appliances. Mr. Brain states that in New South Wales there are 4,000 miles of railway, 120 miles of electric tramway and about 30 miles of steam street railway, all of which are controlled by a railway commission.

Mr. F. W. Warren, who was connected with the Montreal Street Railway in the early days of the introduction of electrical power, has been appointed assistant to Mr. H. S. Holt, president of the Montreal Light, Heat & Power Company. Mr. Warren is a nephew of Mr. James Ross and has represented that gentleman's interests in Birmingham, England, and Jamaica. He succeeded Mr. Hill as comptroller of the Montreal Street Railway, afterwards went to Jamaica, thence to Birmingham, from which place he returns to Montreal.

SPARKS.

The employees of the Bell Telephone Company in Montreal have an association for educational and social purposes and have leased new quarters at 2426 St. Catharine Street.

The city council of Sherbrooke, Que., are applying to Parliament for power to expropriate property within thirty miles of the city with a view to installing a lighting plant at Westbury Basin, near Angus.

Mr. George F. Jackson, of the Bell Telephone Company, has installed a telephone system for the Canadian General Electric Company at Peterborough, Ont., the purpose of which is to connect the various departments. There are some thirty instruments.

Founder's Day at the Clarkson School of Technology at Potsdam, N.Y., of which Mr. William S. Aldrich is director, was this year the occasion of an address of much interest by Mr. H. F. J. Porter, manager of the New York office of the Bethlehem Steel Company. Mr. Porter's subject was "Technical Education and the Higher Industrial Life." A supper in honor of Mr. Porter was given by the Faculty of the school.

Extract from THE CANADIAN ELECTRICAL NEWS, January, 1901, in article describing the plant of the Jacques-Cartier Water Power Company, Quebec.

* * * Pittsburgh transformers are employed. The transformers have a special winding, the two secondary coils each giving 108 volts, so that a single transformer may feed a three-wire set. They have proved peculiarly free from lightning trouble, as in spite of the severe storms of the past summer, not one breakdown has occurred. Before being put into service each transformer is given an eight hour run at full load, iron and copper losses measured and the ratio tested with a standard transformer. From these tests the percentage regulation is obtained, etc., etc. * * * * * * *

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SPARKS.

The Hamilton & Lake Erie Power Company desires to change its name to the Gordon Light, Heat & Power Company.

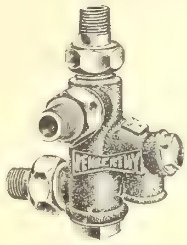
The Berlin Gas & Electric Company, of Berlin, Ont., have been offered $87,500 by the town for their gas and electric light plants.

The Lace & Braid Manufacturing Company, of Toronto Junction, Ont., have installed in their factory a new engine and electric light plant.

The contract recently placed by the Niagara Power Company with Messrs. Escher, Wyss & Company, hydraulic engineers, of Zurich, Switzerland, calls for three turbines of 10,000 horse power each, making a total of 30,000 horse power. These turbines are said to be the largest which have yet been made in the world.

The Ottawa Electric Company have secured the contract for lighting the village of Ottawa East, Ont. They will immediately install fifty 32 c.p. incandescent lamps.

Two electric locomotives are being used in the construction of the tunnel for the Vancouver Power Company at Coquitlam Lake, B. C. They will be employed for hauling the cars conveying the debris from the interior of the tunnel to the dump at the tunnel portal. They are about 20 horse power and weigh 10,000 pounds each.



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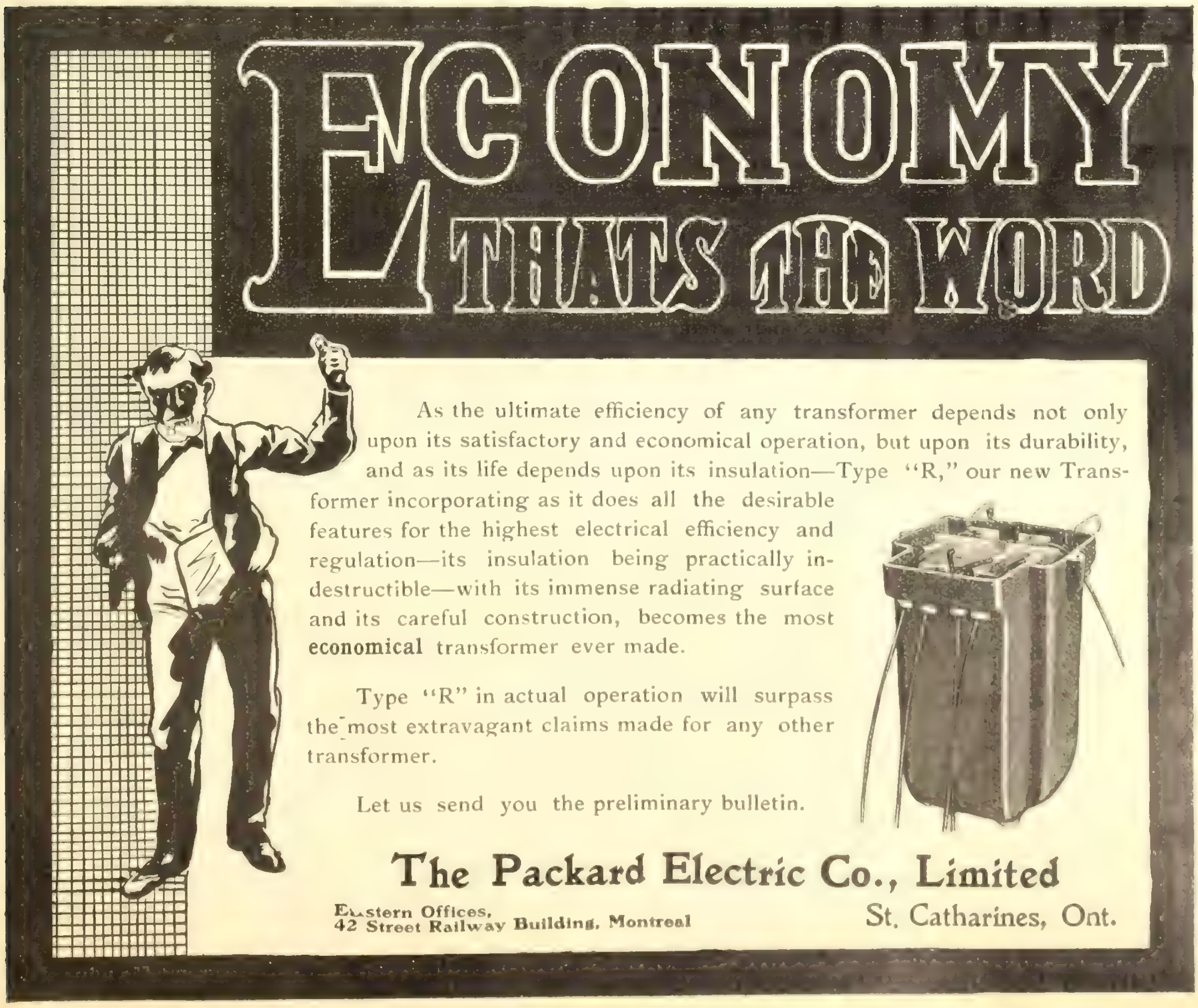

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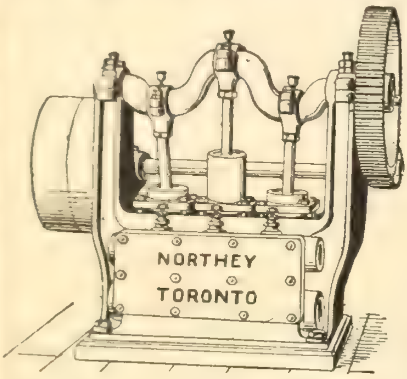

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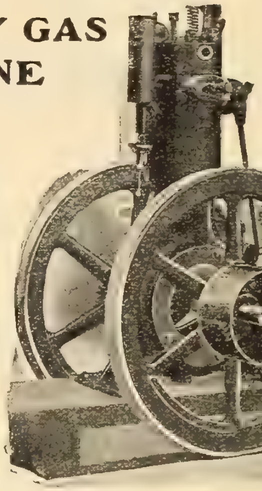

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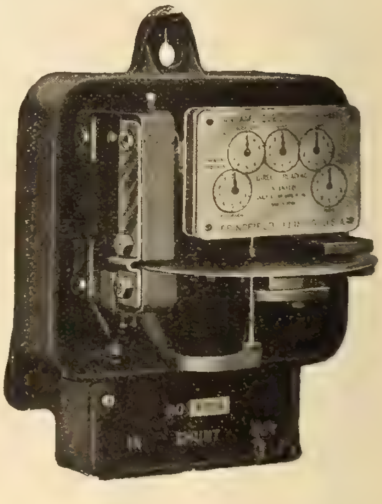

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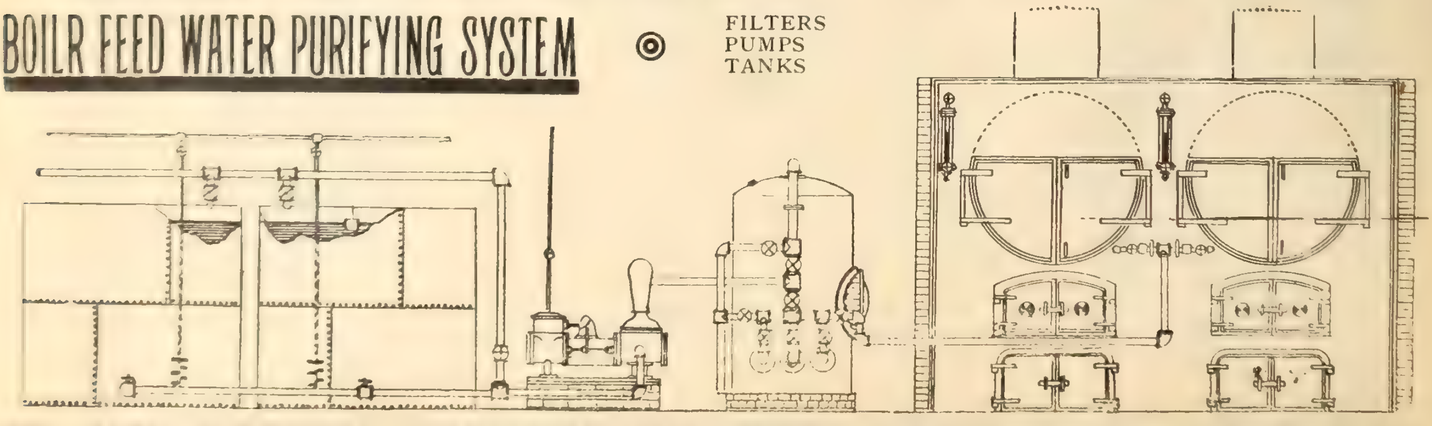

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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIII. JANUARY, 1903 No. 1.

MANUFACTURING PLANT OF DICK, KERR & COMPANY.

About three years ago the English Electric Manufacturing Company commenced the erection of large works at Preston, England, for the manufacture of electric machinery, Messrs. Dick, Kerr & Company, of London, being large stock holders and acting as selling agents for their apparatus. The latter company recently absorbed the English Electric Manufacturing Company, and now conduct both the manufacturing and sales departments under the name of Dick, Kerr & Company.

This company set out with a determination to meet the American competition, which meant a bold departure from English methods. The works that have been constructed at Preston are quite remarkable, the equipment and machinery being in complete accord with modern ideas as to the constitution of a factory and embracing all labor and time-saving appliances which experience suggests. This is evidenced by the following particulars and illustrations of the plant:

BUILDINGS.

Of the twelve acres of land embraced in the company's manufacturing site, about five acres are under roof. The buildings are one storey high throughout except the offices; they are laid out on the lines of the most recent American engineering works, a steel frame being first erected to carry the cranes and roof structure, and the sides and ends independently walled in. The principal buildings are three in number—the machine shop with the offices, the foundry with pattern and pattern storage shops, and the power-house.

MACHINE SHOPS.

The largest and most important of the buildings is,

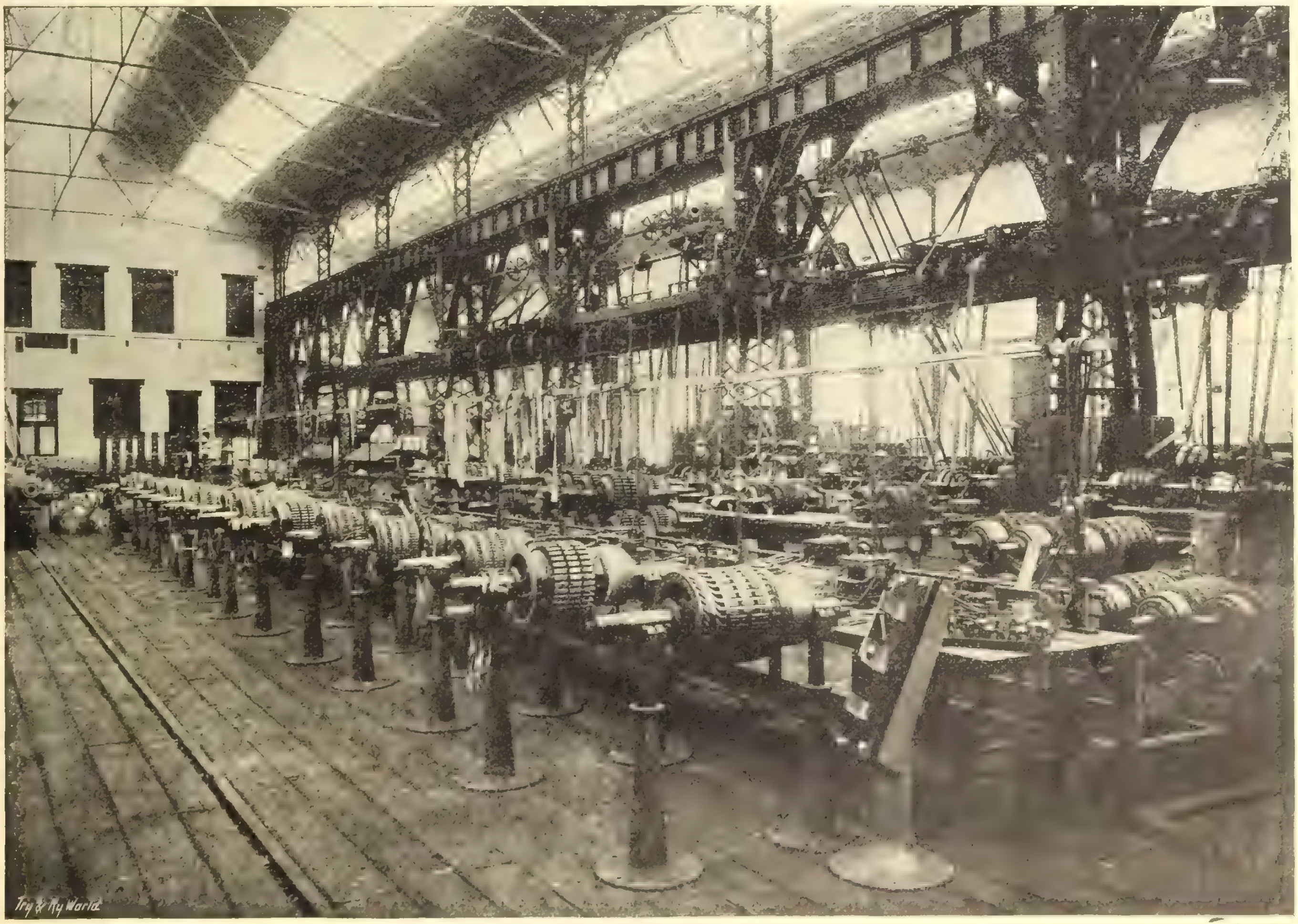

FIG. 1.—ARMATURE WINDING DEPARTMENT.

of course, the machine shop, which is in itself a structure of imposing dimensions 900 feet in length by 120 feet wide, 35 feet high in the clear, and with 25 feet head room under the cranes. Throughout the centre of this building, from end to end, passes a line of double lattice-work stanchions which perform the triple functon of supporting the roof, the crane girders, and the line shafting.

In the general arrangement of the works, and especially in the detailed plans of the machine shop, it has been the chief object to avoid wherever possible the handling and re-handling of the various parts of the apparatus during the processes of manufacture. Raw materials delivered at one end of the main building pass through the successive operations, always moving in one direction, and emerge at the other end as finished and tested apparatus, ready for loading upon the railway trucks waiting to receive it for transportation to any part of the country. Exceptional attention has been paid to the matter of facilitating the progress of the material through the shops by means of powerful high-speed electric cranes supplemented by pneumatic hoists and tracks in every building.

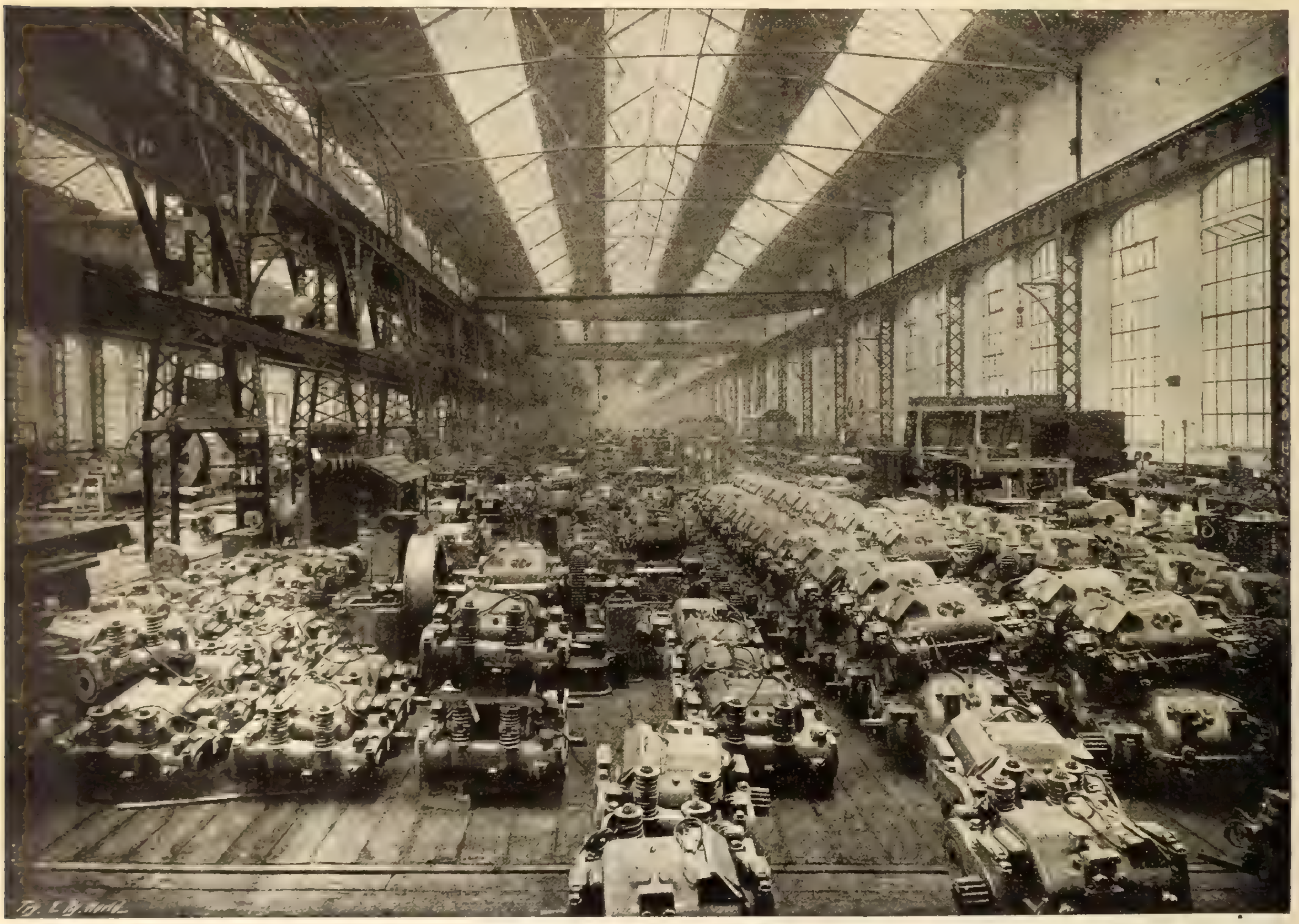

Fig. 2.—Tramway Motor Department.

By means of jib cranes and pneumatic hoists the men operting machines are able to lift into their tools pieces weighing from one to two tons each. Down each bay of the shop is laid a push car track, with an additional track in the centre of the shop running between the stanchions which support the countershafts, cranes, and roofs. It will thus be seen that, in addition to the four large cranes provided in the machine shop, there are three tracks running its full length, thus giving seven ways of handling material up and down the shop.

To facilitate communication between the various parts of the works a telephone system is provided, extending from the offices to all departments. Compressed air at 100 lbs. pressure is distributed to every part of the works, and used in the operation of pneumatic drills, hammers, etc., as well as for operating the pneumatic hoists.

The whole machinery throughout the works is, of course, operated by electric power from the generating station. The limits to which the principle of sub-division of power into small units could be advantageously extended has been most carefully considered. The resulting arrangement in so far as the machine shop is concerned represents entirely new practice, and is worthy of being described in some detail. As has been stated, a sectional line shaft extending the full length of the machine shop is supported from the line of centre stanchions between the two main bays of the shop. The sections of this shaft are driven by individual 50-h. p. motors, direct connected to them by means of a quill shaft and clutch.

The 800 feet of shaft is divided into eight of these sections with their motors; any section of the shafting can be driven by its own motor, or the whole can be driven by any one or more motors. All of the machine tools used in both bays of the shop are thus driven from the one line shaft, except in the case of larger tools, where individual motors are provided. It will be seen that by this arrangement the greatest possible efficiency is secured in the drive of the machinery, since the grouping of the tools of both bays together allows the use of comparatively large and therefore efficient motors, and the frictional losses are cut down to a minimum.

The machine shop is divided into two enormous bays, one on either side of the centre stanchion. One of these bays is devoted entirely to the manufacture of traction motors and details of equipment, while the other is used for the production of heavier machines, such as large dynamos, alternators, rotary transformers, etc. In order to obtain a clear idea of the machine-tool equipment of the shops, and of the operations which are carried on, the simplest method will probably be to [make an imaginary journey through the shops.

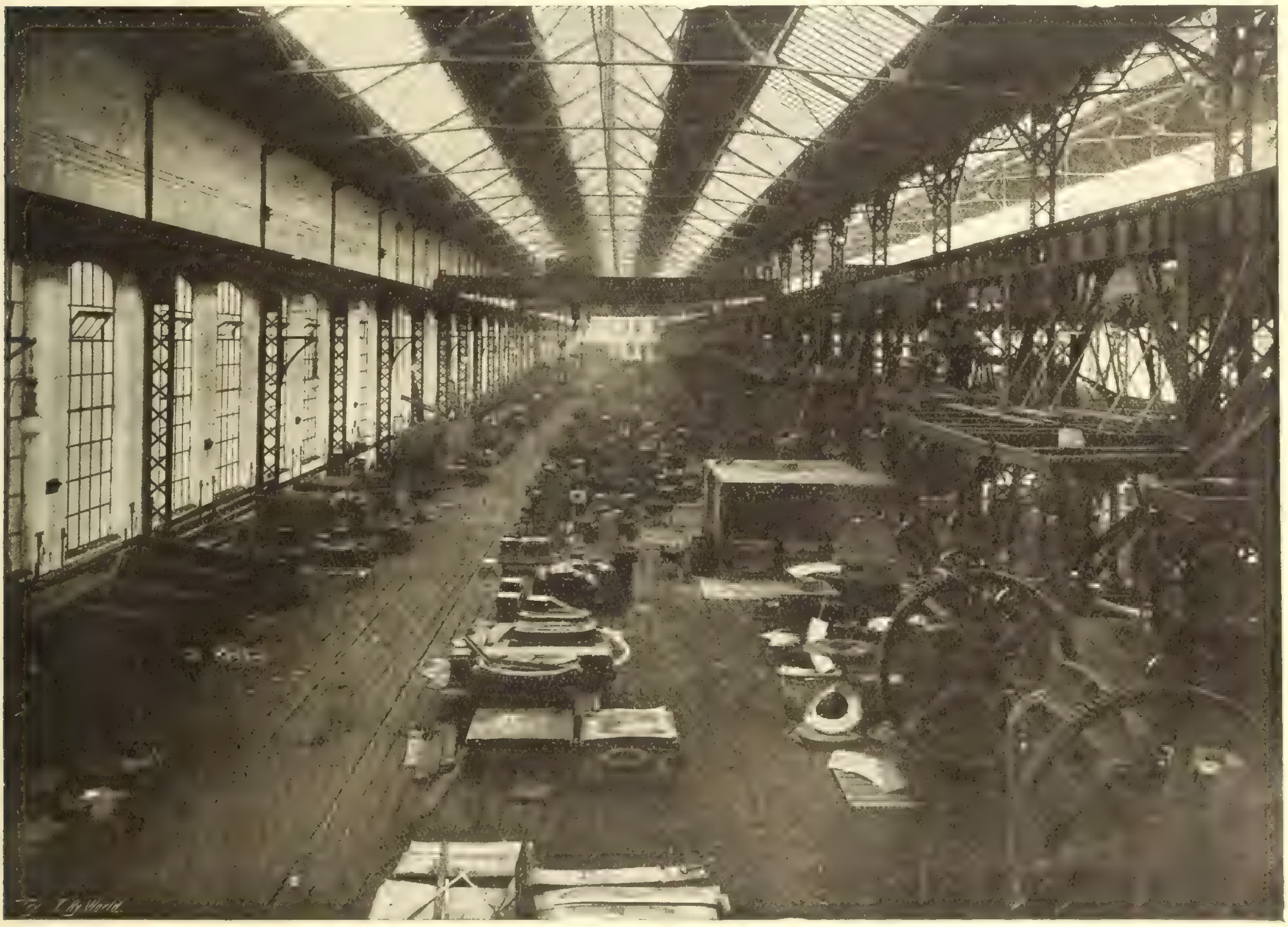

FIG. 3 GENERAL VIEW OF MOTOR BAY.

At the north end of the shop are the receiving and store rooms, into which the receiving track passes. These rooms are fitted with divisions and bins for the reception of the various materials to be used in the manufacture of apparatus. The electric cranes in the two bays unload the materials from the railway trucks and distribute them to the various parts of the store room. From this store room the materials are distributed to the various departments of the works as required.

The first group of tools after leaving the store room constitute the punch and die departments, in which the steel discs required for building up armatures, field magnet cores, etc., are punched with dies into the required shape. Immediately convenient to the punch and die departments is a completely equipped smith shop with power driven hammers, etc., for shaping the steel from which the dies are made. The delicate process of tempering the dies after completion is also carried on at these forges. The die department is fitted with a full equipment of standard lathes, shapers and drill pressers. Worth notice, too, are the grinding machines for grinding the dies with flat cutting surfaces, which slowly move the piece of work backwards and forwards while the large grinding cylinders roll rapidly, and at the same time move along their axes at right angles to the movement of the work, thus ensuring perfectly flat surfaces. Next comes the annealing process, where the armature discs are packed into iron cases and covered with sand to exclude the air. They are then placed in ovens, where they are raised to a dull red heat and then slowly cooled; afterwards being passed through the painting machines, which cover them with the thinnest possible layer of varnish. Issuing from the varnish rools they are dropped on to a moving chain belt, which passes them through a drying oven and delivers them in the assembling department to be built up into cores ready for winding.

Moving down the shop, we now come to a second railway track entering the machine shop from the foundry. By means of this track the castings of motor and generator frames are delivered directly to the respective departments equipped for their completion. The first process with the motor castings is to place them on the vertical milling machines, which face the two halves to form a perfect magnetic joint. Next in line are the radial drilling machines, which drill all the holes in the motor frames. After being bolted together, the frames are placed on the horizontal boring mills, which finish the bearings for the armature and axle and bore out the frames to receive the pole-pieces. The frames are now completed and ready for delivery to the motor assembling section. Coming next to this group of magnificent boring mills are the motor shaft lathes and special machines for grinding the armature shaft bearings. Then come the massive turret lathes for finishing the armature and plates, the commutator heads, and the bearing shells. The next group of tools comprising lathes, planers, shapers, milling machines, and many special tools, constitute the brass-working department, where the controllers, rheostats, trolleys, commutators, and brush-holders are made.

The next department is the field-magnet winding section, where the motor and generator field-magnets are wound, insulated and baked, and the armature coils placed on the motor armature cores. The motors and controllers have now reached the assembling and painting department, from which they are delivered to the testing department, where they are subjected to severe tests for insulation, etc., and run under full and over load conditions for the specified time. After the tests are completed the temperature of each part is taken, and a thorough examination made as to the quality of workmanship, etc. If perfect in every respect, the completed machine is taken charge of by the shipping department, where it is loaded into trucks on the shipping track, which enters the building at the opposite end from the receiving track.

ARMATURE WINDING AND MICA DEPARTMENT.

The armature winding, insulating, and mica department for motors, dynamos, and alternators is separated from the main portion of the machine shop occupying the extreme south end of the generator bay. A brief description of the operations which take place in this department will be of interest. The armature coils, which are wound or formed entirely by machinery, must be thoroughly insulated with mica, paper, and cotton braiding. They must be properly dried, dipped into special varnish, and then baked, in order to exclude all moisture. Afterwards they are pressed into exact shape and formed to size, so that all coils and windings may be alike and interchangeable. The mica rings and tubes for commutators are moulded under great pressure while being heated. The presses in which this work is being done have their various parts heated by steam pipes passing from the boiler-house to this portion of the machine shop. Nearly all the winding, insulating, and mica moulding in the department is done by girls, and its separation from the main portion of the shop obviates the possibility of metallic chips or filings getting into the insulation.

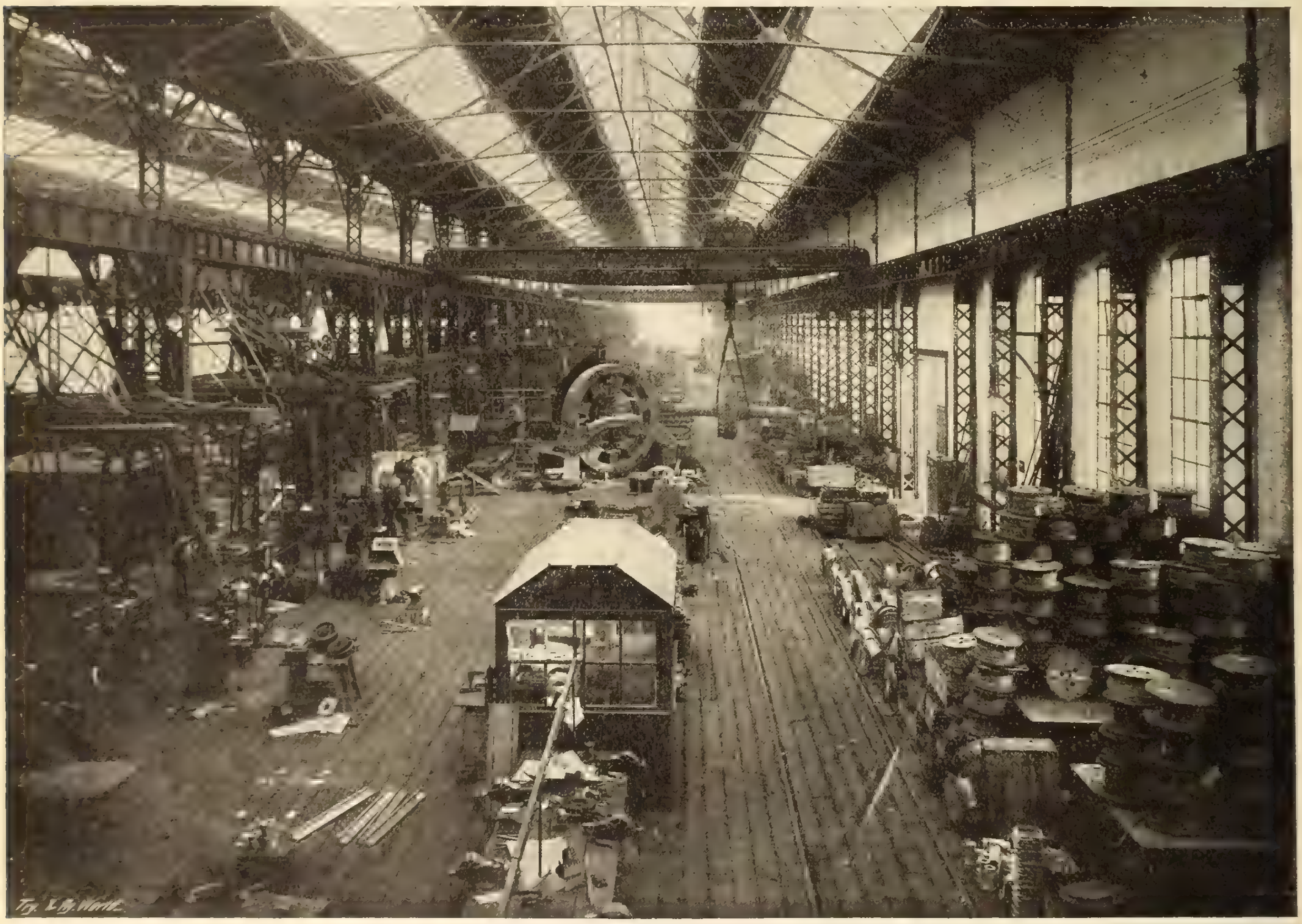

Fig. 4.—General View of Generator Bay.

Returning again to the point where the foundry track enters the machine shop, and coming down the generator side of the shops, we find the largest and finest tools in the plant for machining and finishing the huge generator frames, armature heads, etc. The generator frames after coming from the foundry are first placed on an enormous planing machine, to be faced at the joints. The bed of this planing machine is 24 feet long, and will receive a casting of this length ;

this tool is driven by its own motor, and weighs 75 tons.

The next tool is the largest in the works, being a boring mill swinging 24 feet, for boring out armature heads to receive the engine shafts, to finish the armature end rings for large generators, and to make the large commutators for these machines. This mill weighs over 100 tons. Next comes a universal boring and milling machine which, while not so heavy as the boring mill last mentioned, occupies more room, its table, flush with the floor, being 24 feet square. Along one side of this table travels an upright pillar about 10 feet high. To this pillar is attached a spindle, which can be moved to any position, vertical or horizontal, within the limits of the tool. Generator frame castings are placed upon the table of this machine, the holes are bored, surface milled—in fact, all the remaining machine work being finished without moving the casting. For the armature heads of large dynamos and alternators, portable slotting machines are provided, each with its own motor, which cut the keyways for the engine shafts and the dovetailed slots for fastening the armature laminations. The machine work on the generator frames is now finished, and they next proceed to the assembling department opposite the shipping track, where they are erected for test, each generator being thoroughly tested for insulation, output, temperature and commutation. In the testing room there is arranged a complete switchboard about 48 feet long, with a full assortment of approved testing instruments of wide range. Through the switchboard is also arranged a supply of alternating current at various pressures for testing insulation, and from it as well is distributed all the power for the different parts of the works. In the testing department there is provided live steam from the boiler house, so that complete engine dynamo sets can be tested with perfect ease, and without the necessity of making special arrangements.

FOUNDRY.

The foundry building is parallel with the machine shop, with a space of 60 feet between the two. It is 465 feet in length and 120 feet wide. It is equipped with two 30-ton and two 15-ton electric cranes. In this building are contained the iron foundry department, the brass foundry department, the pattern shops, and the pattern storage shops. Two cupolas are provided for moulding iron, and five brass furnaces for making the brass parts for motors, generators and switchboards. The iron foundry is used for making the frames of the very large generators and alternators for the manufacture of which these works are specially equipped. In both the brass and iron foundries the machine tools provided are driven by an independent motor.

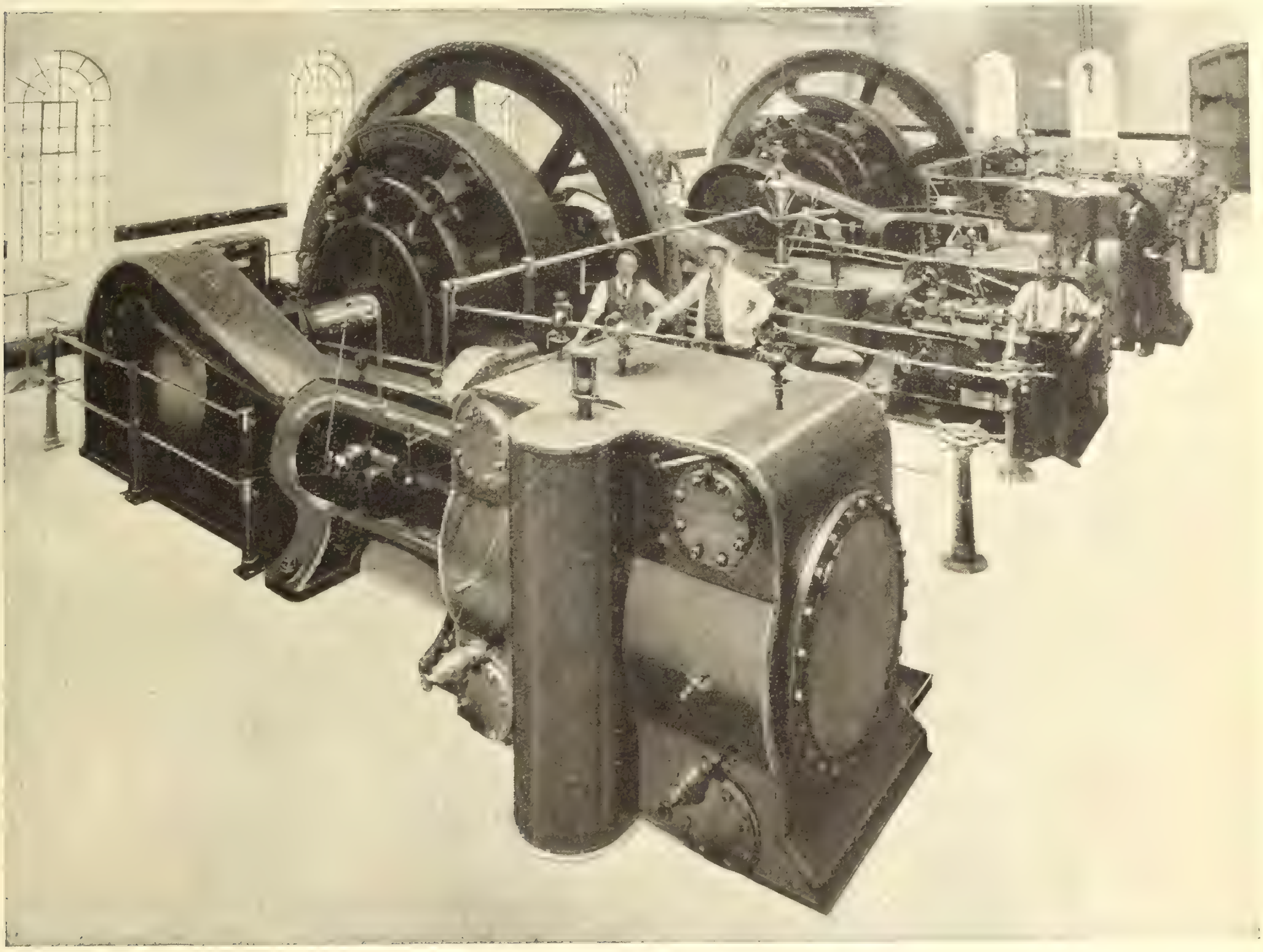

Fig. 5. Interior of Power House.

POWER HOUSE.

To provide the necessary power for the shop operations as well as the lighting calls for considerable plant; for this purpose there are two cross-compound Corliss engines, each direct connected to a generator of 400 horse-power capacity. There is, therefore, available at the present time 800 horse power, with a possible overload capacity of 25 per cent. The battery room contains a 500-volt Chloride accumulator set, which is used for supplying light and power throughout the works at night when the power plant is shut down. The reservoir, with a capacity of 60,000 gallons of water, receives its supply from an elaborate system of roof drains. A cooling tower, erected over one portion of the reservoir, cools the water coming from the condensers of the engines.

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NEW YEAR GREETINGS.

The ELECTRICAL NEWS wishes all its subscribers, advertisers and friends a Prosperous New Year.

Niagara Development. It is interesting to note that the contemplated developments on the Canadian side of the Niagara river will, if carried out in their entirety, result in a total capacity far exceeding those across the line, and further in the light of the experience gained in the operation of the Niagara plant, those now building will possess many new and valuable features not found in the original equipment. The The Canadian Niagara Power Company and the Ontario Power Company are now both at work on their hydraulic development, while a third organization, composed mainly of Toronto gentlemen, is making application for a location and water rights. The installation of these plants will mean the expenditure of many thousands of dollars in all branches of business throughout the country, besides which there will be the equipping of the numerous industries which will doubtless adopt electric illumination and power as soon as the attractive rates of the water driven station are offered to them.

Aluminum. The use of aluminum in the electrical industry has not become common practice to any great extent, though a short time ago the outlook indicated that it would rapidly force its way to the front, and to a material extent replace copper bus bars and line wires. Its general characteristics as compared with copper, of which, outside of the telephone and telegraph fields, it is practically the only competitor, are well known. Weighing about one-third that of copper, with a specific resistance some 40 per cent. greater, and having a tensile strength about 40 per cent. less, it is made commercially pure for such shapes as bus bars, where strength is of no consideration and maximum conductivity is all important; for small wires an alloy of 1 to 2 per cent. is introduced to increase the tensile strength, though slightly greater resistance is the natural result. From the above it follows that an aluminum wire of equal conductivity to any given size of copper will be about 60 per cent. greater in diameter, and while weighing slightly less than half as much, will sustain a somewhat greater load. It cannot be soldered without much trouble and it is therefore customary to make joints in transmission lines by McIntyre connectors, in cables by joint clamps. The self-induction is slightly less than in a copper line of equal conductivity, the skin effect is practically the same, the charging current slightly greater. The effects of varying climates are not very well known, as most of the data now available has been obtained from California, where the thermometer does not go very low, though experience there tends to show that its use beside salt water is almost impractical, as it is very easily attacked by the salt which is carried in suspension in the surrounding atmosphere. It would be interesting to learn what service it would give under the low temperatures which obtain at certain seasons of the year in some parts of this country ; trouble might be expected from excessive slackness or tightness of the lines according as the thermometer went up or down, the coefficient of expansion being somewhat greater than that of copper.

The Steam Turbine. In the struggle to produce goods at the cheapest possible price compatible with a satisfactory product, much attention is naturally given, and has been for years past, to the cost of the power used in manufacturing. This forms a large part of the cost of practically all goods turned out by machinery, and therefore the efforts of all engineers and manufacturers have long been concentrated on attempts to reduce it to the lowest possible point. One of the most obvious means of lessening cost is to increase the rate or size of production, and hence the tendency in steam engineering has been towards constantly increasing engine sizes, until they have reached a point where physical and mechanical conditions call a halt. This being the case, attention is naturally turned elsewhere to find an outlet from the difficulty, and it is to the steam turbine that the eyes of the mechanical world are directed in an effort to get steam power at a cost that is lower than that which now obtains. This new adaptation of an old principle is now rapidly pushing its way to the front as a competitor of the ordinary reciprocating engine, and as its present field is almost entirely that of driving dynamos for power distribution, its development is being watched with great interest by electrical men the world over.

The fundamental difference between the two types of engines is that in the reciprocating form the energy in the steam is used expansively to push a piston along ; in the turbine the power is turned into energy in the shape of velocity. The steam issues from a nozzle at a high speed and then impinging upon the blades of the rotating member turns it round at an extremely fast rate. This at once introduces to the electrical designer a new problem of large, direct-connected dynamos for high speeds, very high speeds, as opposed to the low speeds which have hitherto been required by the present day type. Standard direct-connected units of about 300 k. w. and larger operate at from 100 to 70 revolutions per minute; the steam turbine requires that these figures shall be changed to about 3000 r. p. m., down to 700 or 800. This naturally introduces many new features into the electrical part of the equipment ; on the whole it means smaller and lighter and therefore cheaper dynamos for the same output. Another valuable feature arising from the nature of the apparatus is that there being nothing but rotary motion, as in the water wheel, the difficulties of driving alternators in parallel and the hunting of synchronous apparatus are entirely eliminated, the turning movement or effort is absolutely uniform, and so there is no tendency to generate cross currents between the various machines connected to the circuit. Further than this, due to the high speeds, the fly wheel effect is greater than in ordinary reciprocating units, which means that the new type is able to carry a varying load with closer speed regulation than the other. In the driving of direct current machinery some difficulty is experienced in obtaining satisfactory commutation at the high speeds involved ; perhaps the long abandoned unipolar dynamo may again come into use to surmount this obstacle.

The principal advantages which the turbine offers over the present standard form of steam engine is that even to-day with the comparatively small experience which its builders have had, it has a steam economy practically equal to, if not excelling, the best results which have hitherto been produced by the other type. This is true not only of the larger sizes, but also of the smaller. More noticeable still is the fact that the steam consumption is not very materially increased when running at partial loads. Again, as a natural result of the high speed, the apparatus is smaller and lighter, which means a decreased cost for foundations, power house buildings and the land they stand on. This is especially true of foundations, which can be made materially lighter owing to the absence of all strains or moving tendencies. It has been estimated that they will cost 15 to 30 per cent. of those for the present style of unit, the total power house expenditure outside of the apparatus itself being approximately only 50 per cent. of that required for the reciprocating type. The light weight has a further effect in lessening the total cost,in that shipping and erecting charges are much reduced, as is also the time required for installation, which in large engines as built to-day may occupy many months. Data available at the present minute shows that the use of superheated steam and a high vacuum are prime essentials to the highest steam economy. As there are no rubbing surfaces, such as the piston and cylinder in contact with the steam, the greatest difficulty in the use of superheating, namely, that of obtaining satisfactory lubrication, is not present ; and so we may expect to find this a very prominent feature in future developments. This brings forward another extremely valuable feature, namely, that the condensed steam may be immediately returned to the boilers, without filtration or any other cleansing processes, and still not have any harmful effects upon them, as would be the case did it contain oil, as it does when it comes from an ordinary cylinder. Priming, or the passing over of entrained water from any source, has no dire results such as are so well known to all users of the reciprocating engine ; nothing happens beyond a slackening of the speed until the water has passed through. In those types which use their steam in stages similarly to a compound engine it is usual to provide a bypass whereby high pressure steam may be admitted to the low pressure spaces. This allows the carrying of full load with the condenser shut down ; if it is in operation, 50 to 60 per cent. overload.

Space prevents our giving many interesting examples of the above points, but enough has been said to show the principal differences between the old and the new, and the numerous advantages which the latter appears to offer, not to the large manufacturer only, but also to the smaller industries. That these are being appreciated is evidenced by the many installations, both in course of construction and prospective, which are to have the steam turbine as their prime mover.

A Goldie & McCulloch engine has been installed in the power house of the Canada Carriage Company, Brockville, Ont.

THE WESTERN OHIO ELECTRIC RAILWAY.

The Western Ohio Railway Company operates at the present time 47 miles of road and has under construction 64.5 miles more. The portion of the line now in operation begins at Lima, in Allen County, Ohio, runs south from Lima to Cridersville and Wapakoneta, west to St. Marys, south from St. Marys to New Bremen and Minster and finally west from St. Marys to Celina.

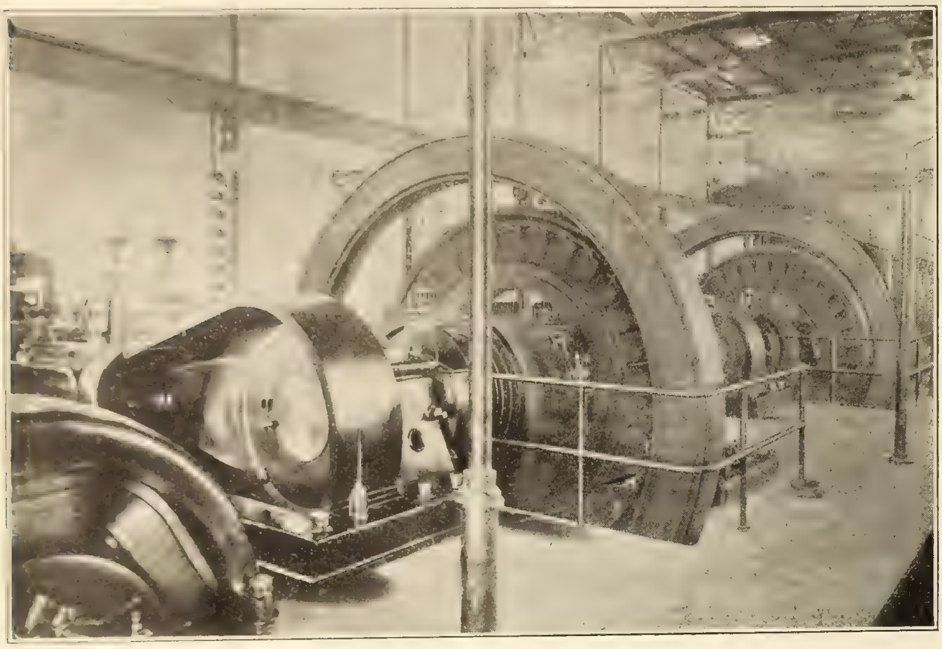


Fig.—Two 400-Kilowatt Three-Phase Alternating-Current Engine-Type Alternators, 400 Volts, 100 Revolutions per Minute.

The main power house is located at St. Marys. The building is of brick and concrete of the following general dimensions: Extreme width, 104 feet; extreme length, 248 feet; width of boiler room, 45 feet; and width of engine room, 52 feet. The roof over the entire building consists of flat steel trusses carrying three-inch tile, with a four ply asphalt and gravel covering. The engine room is supplied with a 25-ton Chisholm & Moore, hand-power travelling crane.

The maximum capacity of this station, according to the present plans, will be 4,000 k.w. The engines are of the C. & G. Cooper, horizontal, cross-compound, condensing type, with Corliss valve gear, and were designed for parallel operation on alternating current three-phase work, with a guaranteed regulation of 1 per cent. The boiler equipment consists of eight Stirling boilers, of a total capacity of 6,000 h.p. These boilers are equipped with flat grates and are all hand fired, coal being supplied directly in front of the fire doors by a Hunt industrial railway system consisting of a narraw gauge track with turnouts, track, scales and steel cars, each having a net capacity of one ton.

The pump and condenser room in this plant is located in the centre of the main boiler room and contains all of the feed pumps, feed-water heaters, circulating pumps, vacuum pumps and condensers for the entire plant. The main steam header consists of 16-in. heavy, lap-welded, steel pipe. Valves over 8-in. in diameter are by-passed. The main steam header is carried on a specially designed, cast-iron roller frame, one end resting on the rear of the upper walls of the boiler setting, and the other being built into the brick-work of the division wall between the boiler and engine rooms. All feed valves are arranged to be controlled from the boiler floor line, as are, also, all drips, gauge-cocks, water gauges, water columns, blow-off pipes and drains around the boilers.

The electrical apparatus was furnished by the Westinghouse Electric & Mfg. Company, of Pittsburg. The main generating units are direct connected to their several engines and each of the two units now in operation is of 400 k. w. capacity. The machines are of the revolving armature type, the armatures having three-phase windings for a normal out-put of 400 k. w. Throughout the armature spider, core and winding, large ventilating ducts have been provided which permit a free circulation of air during operation. For exciting the main generators there will be two units, both steam driven and of the Westinghouse type, the generators, of 100 k.w. capacity and opreating at 125 volts and 200 r.p.m., being direct connected to two 13 x 22 x 13-in. Westinghouse compound engines.

The main power house contains also a sub-station, that is, a portion of the low potential current from the main generators is carried to two 400 k. w. rotary converters supplying approximately 25 miles of the feeder system of the line. The rotary converters in the other sub-stations are all of the Westinghouse type and of 200 k.w. capacity. The armature winding of the rotary converters is similar to that of ordinary direct current generators, but it is tapped at certain points from which leads are carried to collector rings at one end of the staff, while the ordinary direct current commutator is at the other end. The ratio of conversion, A.C. to D.C., is about 0.62. These rotary converters operate at a speed of 500 r.p.m., and deliver 333 amperes at 600 volts. For starting a small induction motor is permanently mounted on the same shaft with the armature.

The engine room at the power house will contain two switchboards, a main generating board containing eleven panels and an alternating current board of nine panels, upon which will be

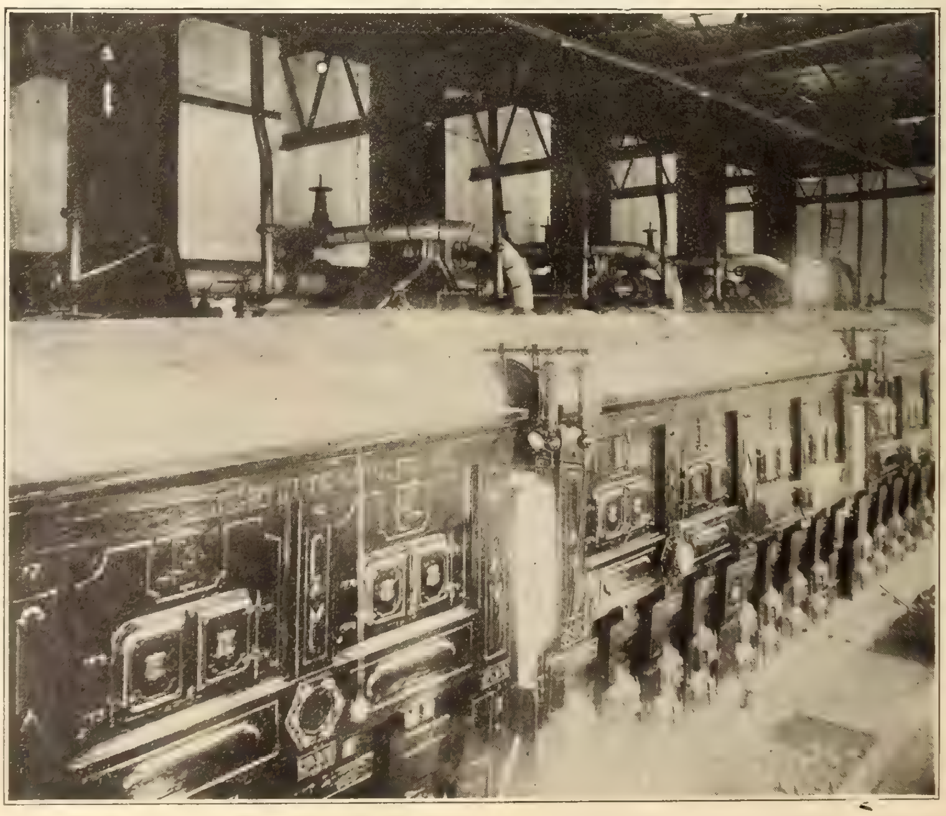


Fig. 2.—Partial View of Boiler Room, Central Power-House, St. Mary's, Ohio.

mounted the high tension switches for all outgoing transmission lines. All instruments on the boards are of the Westinghouse, long scale, dead-beat type.

The step-up stationary transformers, which are located in the basement, are of the Westinghouse oil-cooled type. There will be seven of 400 k.w. capacity, transforming the current from 390 to 33,000 volts. From the transformers lead-covered, single-conductor cables will be led up the south wall of the building to the high-potential circuit-breakers, of which there will be nine of the Westinghouse type mounted on a wooden frame-work.

The sub-stations along the route will be seven in number and will be located as follows: Rawson, Beaver Dam, Lima, Wapakoneta, Anna, Sidney and Lockington. The sub-station buildings will be of brick, with 13-in. walls above the foundation line, the coping being covered with cement. The floors in all sub-stations are to be of concrete, as are also the transformer pits.

In addition to the sub-stations mentioned, there will be a portable sub-station mounted on a car. The equipment includes one 200-k. w. rotary converter; three 150-k. w. step-down transformers; three "low-equivalent" lightning arresters; three fuse switch circuit-breakers with barriers, and one three-panel switchboard.

The high tension line from Wapakoneta to St. Marys is carried on 45-ft. poles, the top of the poles being arranged for three sets of 33,000-volt lines. At Wapakoneta one set turns off south and supplies the sub-stations at Anna, Sidney and Lockington. The other two sets continue north as far as Lima, one set supplying Wapakoneta and Lima and the second set supplying Beaver Dam and Rawson. The transmission cables themselves are all carried on steel pins with wooden tops and porcelain insulators. The cross arms are of long-leaf yellow pine, fastened to the pole with two ½x12-in. carriage bolts. All the high-tension lines are completely spiralled every mile, each set being spiralled on a direction opposite to the adjoining one, this keeping the same phase feeders on the two pins next to the pole on each side.

The first eight cars on this road were built by the G. C. Kuhlman Company, of Cleveland, and comprise five passenger coaches and three combination passenger and express coaches. The cars are 42 ft. 6 ins. over all and are mounted on Peckham trucks. The electrical equipment consists of four Westinghouse No. 56 railway motors. All cars are double motored and are geared up to a maximum speed of 48 miles per hour. Straight air brakes are used and each car is supplied with an independent motor-driven compressor mounted on a dust-proof box on the under side of the car.

The road bed on the first 47 miles of this property is of standard interurban railway construction, consisting of 60-lb. steel rails 30 ft. in length laid on 5 x 7 x 7-in. ties. The road bed is heavily ballasted throughout with rock crushed to 1½-in. ring gauge and screened, and is from 8 to 12 ins. in thickness under the ties. The entire line is built upon private right of way. The maximum grades on the line now operating will not exceed 2 per cent except at points where the line crosses over the main lines of steam roads.

The poles on this line are all of Michigan cedar, 35 and 45-ft. lengths with 7-in. tops, all thoroughly guyed and braced on all curves. It has been the aim to make the over-head line substantial in order to stand the high speed of heavy railway cars. Above the trolley is strung a 211,000 C.M. feeder, carried on a cross-arm 12 ins. above the trolley bracket. On these same cross-arms over the entire route are carried the telephone lines, there being an iron box telephone in a wooden booth at each turn-out, where all cars must report. This telephone system is carried into the general offices of the company at Lima, where the despatcher is located, so that he is constantly in communication with all of the cars on the system, as well as the power-house and sub-stations.

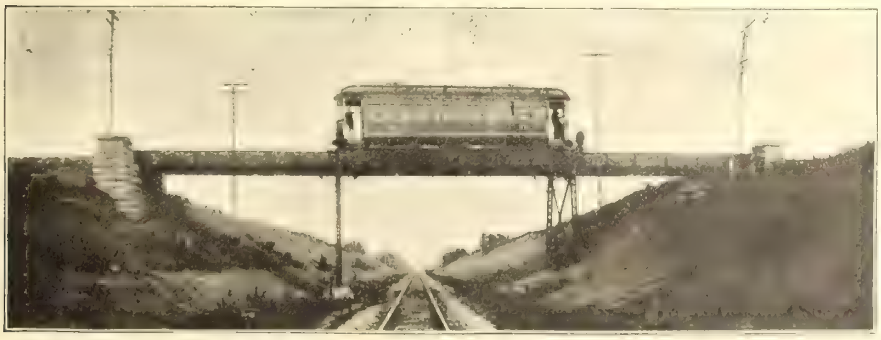


Fig. 3.—Overhead Crossing, Western Ohio Railway, over Track of Chicago & Erie Railroad.

The portion of the road now in operation traverses the Lima-St. Mary's oil fields, which are among the heaviest oil producing districts in the country. It also traverses a rich farming territory and the prospects for freight on this road are very bright. The rate of fare charged is approximately two cents per mile, and the run from Lima to Minster, a distance of 36.8 miles, is being made in 1 hour and 46 minutes including all stops.

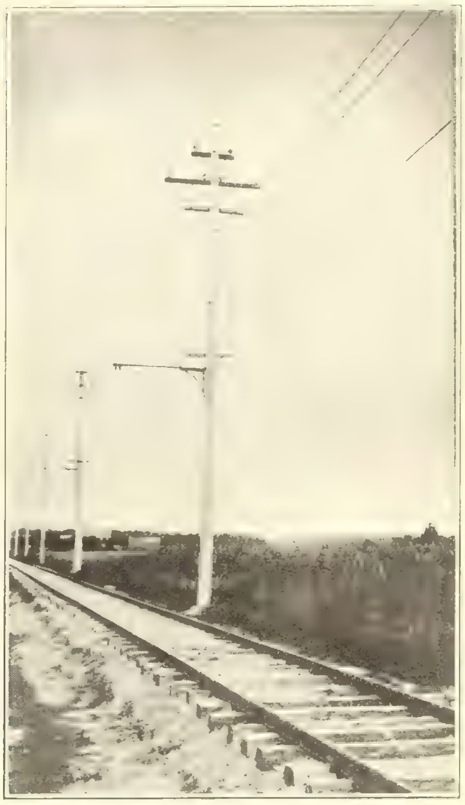


Fig. 4.—Forty-Five-Foot Pole Line Carrying Both Trolley and Transmission Circuits.

THE SHAWINIGAN TRANSMISSION LINE.

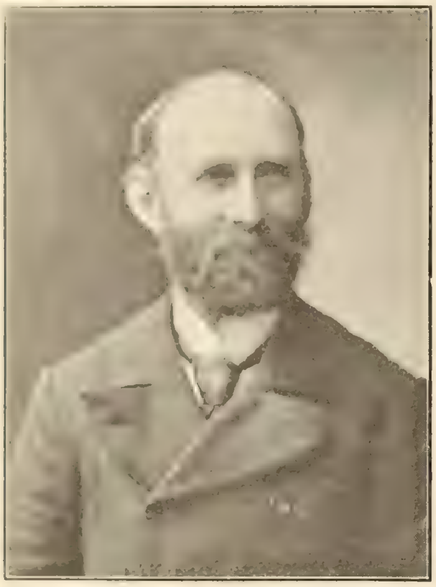
The pole line for transmitting electric power from Shawinigan Falls, Que., to Montreal, a distance of eighty-five miles, has been completed. The power will be utilized by the Lachine Rapids Hydraulic & Land Company, who have been making extensive improvements with that end in view. It is proposed to transmit 8,000 electrical horse power. The current will be brought into the city at 50,000 volts. At the distributing station it will be stepped-down to 2,000 volts, at which pressure the 8,000 horse power will be delivered to the Lachine Company. One of the interesting features of this work is the fact that aluminum wire is used for transmission purposes. It is the first output from the factory of the Northern Aluminum Company, the Shawinigan branch of the Pittsburg Reduction Company. It is expected that the Shawinigan plant will, in a few years, be the largest aluminum-producing plant in the world.

Some 4,500 poles have been planted for the support of the three aluminum conductors which are strung upon them. Each conductor consists of six ⅜″ wires twisted together. A special porcelain insulator has been used.

At Bout de l'Ile the river is spanned and the Island of Montreal reached by means of a heavy steel cable, suspended above the water from two steel towers, one on each shore. The span is 1800 feet in length.

DEMISE OF AN ELECTRICAL INVENTOR.

In the death of George Henry Bingham Hooper, which occurred at Grace Hospital, Toronto, on December 9th, 1902, there passed away an inventor and electrician who had devoted a life-time to perfecting the design of apparatus pertaining to the electrical industry. His inventions included a generator, a circuit breaker, an improvement in storage batteries, the Hooper electric marine engine, an automatic cartridge extractor, and an improved lathe device. His greatest accomplishment, however, and that to which he had given most attention and study in recent years, was the Hooper magnetic electric brake, the design of which is shown in the accompaning illustration.



The Late G. H. B. Hooper.

The late Mr. Hooper was a very enthusiastic electrician, and it may be truly said that he never received the financial reward to which his inventive genius was entitled. At the time of his death a company was in process of formation to exploit and manufacture his electric brake, but after spending many years in its development, and just when it seemed he was about to reach the ultimate goal, he fell a victim to the continuous strain imposed upon his delicate health. When Mr. Hooper realized that death was approaching he expressed his keen regret that he could not live to see his brake in commercial operation. He had spent his entire means in experimenting and securing patents in Canada, United States, Great Britain, Italy, New South Wales, Victoria, New Zealand and Belgium.

A test of the brake was made by the Hamilton Street Railway Company on October 10th, 1901. It was found very efficient and satisfactory, and received the endorsation of Mr. E. Wingate, then city engineer, who in a testimonial letter says : "I have no hesitation in recommending it to be a first-class improvement and in every way superior to anything now existing in the line of street car brakes." It is understood that the patents covering the brake will be sold for the benefit of Mr. Hooper's young children.

As the inventor was of a secretive disposition, little is known of this brake by the public. We, therefore, give below a statement of the claims made for it in the original application for a patent dated April 24th, 1899 :

IMPROVEMENTS IN ELECTRIC BRAKES.

I, George Henery Bingham Hooper, of 8 Treford Place, in the City of Toronto, in the County of York, in the Province of Ontario, Canada, electrician, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statements :—

My invention relates to improvements in electric brakes for car and other wheels, and the object of the invention is to design a simple and effectual form of brake shoe in which the lines of force passing through the ends will act with the greatest strength upon the perimeter of the wheel, and it consists essentially of a brake shoe having the major portion of the magnet formed on a circle having a less arc than the contracting pole ends, which are formed concentric to the center of the wheel to which the brake is applied and extend out entirely beyond the wound portion of the magnetic shoe, the parts being otherwise constructed and arranged in detail as hereinafter more particularly explained.

Fig. 1. is a side elevation showing the application of my brake to a wheel.

Fig. 2. is a sectional plan of the brake-shoe and portion of the wheel showing the means whereby such brake-shoe is normally held from contact with the wheel.

Fig. 3 is a detail of an alternative form.

In the drawings like letters of reference indicate corresponding parts in each figure. A is a wheel having an iron rim and designed to be a wheel of a car or other vehicle or wheel on a shaft or any other wheel to which it is necessary to apply a brake. B is my brake-shoe comprising a magnet portion B1 wound as specified and the end contracting pole portion B2. It will be noticed that the pole portions B2 extend outwardly entirely to the outside of the magnet portion B1, and are formed in arcs concentric to the perimeter of the wheel.

The portion 1 it will be noticed is formed on an arc described from a less radius than that of the arcs of the pole ends. By providing outwardly extending pole ends as described the magnet lines of force are allowed a freer passage to the perimeter of the wheel and being entirely outside of the portion B1, there is no danger of short circuiting between the poles as would be the case if the poles approached each other or were close together.

The magnetic brake-shoe is held in position by a link C pivotally connected to the top of the shoe and suspended from a loop D. E are the wires running to the wound portion, which wires are provided at any convenient point with a suitable switch to throw the current into the magnet when desired.

The magnet shoe B is held from lateral displacement by the hanger F, provided with the jaws f between which the shoe fits.

In order to hold the shoe positively free of the [illegible], provide an electric band f 1 which is passed around the magnet at one end and a hook f 2 on the hanger F at the opposite end.

It will be noticed in figure 3 that I provide a straddling bracket G, which I bolt at each end to the core of the magnet. The rod G1 connects the bracket G to the opposite bracket and the brake is supported by a link as hereinbefore shown. The brake levers and shoes will be connected with this rod as in any other brake and such brake could be put on by hand if desired.

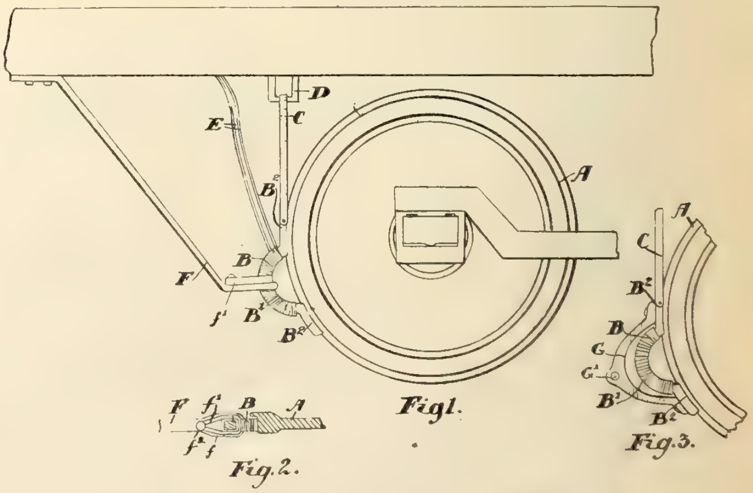
It will be seen from this description that by the construction of my brake shoe I am able to procure a much better grip upon the surface of the wheel than of those heretofore devised of which I am aware.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is :—

1. A brake for wheels comprising a bar magnet of uniform cross section throughout, having the wound portion formed in a core the arc of which is that of a circle less than that of the rim of the wheel to which it extends, pole ends extending entirely outside such arc and formed on arcs concentric to the perimeter of the wheel and having their inner arc shaped sides disposed to contact with the wheel as specified.

2. A brake for wheels comprising a bar magnet having the wound portion formed on a core, the arc of which is that of a circle less than the arc of the rim of the wheel to which it extends, pole ends extending entirely outside such arc and formed on arcs concentric to the perimeter of the wheel and having their inner arc shaped sides disposed to contact with the wheel, a link supporting the same pivotally connected at the bottom to the top of the arc shaped pole and thereby leaving the opposite pole end perfectly free and the inner side of both pole ends disposed to contact with the wheel, a rigidly supported guiding hanger having the bottom end embracing the central portion of the core and limiting its movement, and a suitable spring connected to the magnetic brake-shoe at the centre and to a suitable portion of the hanger at the opposite end, as specified.

3. A brake for wheels comprising a bar magnet of uniform cross section throughout having the wound portion formed on a core the arc of which is that of a circle less than that of the rim of the wheel to which it extends, pole ends extending entirely outside such arc and formed on arcs concentric to the perimeter of the wheel and having their inner arc shaped sides disposed to contact with the wheel, and links supporting the bar magnet and the straddle bracket secured to the ends of the core and provided with a cross rod as and for the purpose specified.



The Hocper Magnetic Electric Brake.

QUESTIONS AND ANSWERS

"Reader": The writer signing himself "Ordinary Reason" in your last issue is not so far wrong. No. 18 old code was ordered out in Montreal a year or two ago and No. 16 (old code) advised in its place. Now No. 16 old code and everything "old code" is ordered out to be supplanted by No. 18 new code (or larger), taking special socket bushings, socket handles, etc., whereas the cord required for portable extension lamps, of which sample is sent, is about as handy as a steamboat hawser. Let the Underwriters have a "competent" inspector, allow him to make the "materials to suit the case," and drop that "pocket directory" of theirs.

ANS.—We do not clearly understand what your objections are. Surely every encouragment should be given to an effort to make wiring more safe, and the increase in the size of the conductor most certainly tends toward that end. Moreover, this end is accomplished without extra cost to those who pay for the wiring, as manufacturers quote the same price on both No. 18 and No. 16 flexible cord. We have not heard of any wiring being ordered out wholesale, as your communication indicates, more especially if accompanied by the substitution of No. 18 for No. 16. The sample you send us is of very poor quality.

"J. W. M.": Would you kindly advise me if you know of any firm in Toronto who manufacture an emergency street car brake.

ANS.—The Momentum Brake Company, Victoria Street, Toronto, manufacture a mechanical brake which is designed like the air system to act as an emergency equipment as well as to be used for ordinary service stops. The Canadian General Electtic Company and other supply companies handle various types of electric brake control which, like the above, are suitable for emergency as well as ordinary stops.

"Engineer": Will a three phase motor operate off a single phase circuit?

ANS.—After it has been started it will run and give an output which is about 70 per cent. of that which it will develop if run off a three-phase line, but it will not start itself. You will have to bring it up to somewhere near full speed either by hand or by some auxiliary starting device such as a condenser and compensator, or other phase splitting winding.

Chicoutimi Electric Company, Chicoutimi, Que.: Our system is S. K. C. 2080 volt to 104 volt, by which we run a 30 h. p. 500 volt induction motor of same make. Owing to variations in water wheels the voltage fluctuation is great, causing the fuses on the condensers to blow out frequently. Out of forty plates sometimes 10 to 15 go in a day. What would be the cause? Should we not use the condensers, or if we should use them what kind of fuse should we use? The replacing of the fuses means time and labor, and the repairs to the plate are so expensive that the use of this kind of motor does not pay. What would you suggest?

ANS.—If the fluctuations in your voltage are causing your condensers to break down, the only remedy is either to stop the fluctuations or to put in condensers which will stand up under that service. If the condensers do not break down, but simply take more current when the voltage rises, and thus blow the fuse, we would say that the latter was on the small side, and should be made larger. You will find it scarcely practicable to operate without the condensers; as the motor will take more current from the generator and will also cause a greater drop in the voltage.

"Subscriber," Montreal: What will be the results if a 60 cycle transformer is operated on a 125 cycle circuit, and vice versa?

ANS.—The core loss, heating, and magnetizing current will be less, the regulation not quite so good, and the efficiency greater, though you will understand that the practical differences, as viewed from the results obtnined in service, are but small. The converse is true on all points for a 125 cycle transformer running on a 60 cycle circuit.

"X. Y. Z," Midland:—What is the difference between a cycle and an alternation?

ANS.—An alternation is the name given to the movement of an alternating current which, starting at zero, gradually rises to a maximum and then falls, at the same rate, to zero again, flowing during this operation all in the same direction. At the next alternation the current rises and falls in the same manner, but in the opposite direction. At the end of this second movement or alternation the current again starts to flow in the same direction as at first. The first two alternations form a cycle, which as its name implies, covers the round or cycle of operations necessary to bring the current back to where it started from, ready to begin all over again. It will thus be seen that a cycle occupies just twice the time of an alternation, or in other words, consists of two successive alternations.

"Station Superintendent": What do you consider the best practice in setting the base frames of direct connected dynamos? Where should the floor be? What is the best thing to use under the frame to hold it in place?

ANS.—Unless special conditions render some other elevation desirable, we would make the foundations of such a height as would set the bottom of the dynamo base one to five inches below the floor line, the exact figure depending on the size of the machine. For grouting in you can use the ordinary rust joint, which is made of cast iron borings, sulphur and salammoniac, or else melted sulphur, though perhaps the cheapest and most reliable of all is ordinary cement, of a first-class quality.

"Engineer": What is the maximum load which an ordinary steam engine will carry, compared with its normal load?

ANS.—It is very difficult to give any exact figure, as the method of rating adopted by the manufacturer, variation in steam pressure, allowable drop in speed, etc., etc., all affect the result. Speaking generally, we would say that you ought to be able to carry 1½ to 1¾ times the rated load of the engine.

TELEGRAPH and TELEPHONE

WIRELESS TELEPHONY BY THE COLLINS SYSTEM.

By A. Frederick Collins.

While experimenters have been striving for many years to produce a pratical method of transmitting signals without connecting wires they have given comparatively little attention to wireless telephony.

The reasons for this are several, the foremost of which has been due to the fact that the gigantic obstacles in the way of the latter were believed to overbalance its value, e.g., any kind of an electric current, direct, alternating, interrupted or oscillatory, may be utilized in the sending of a message by the dot and dash code, but in the emission, propagation and reproduction of articulate speech an alternating current having the same phase, amplitude and frequency at either end, i.e., syntonized and synchronized, is necessary.

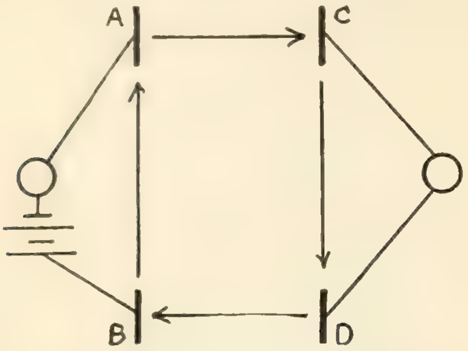


Fig. 1.—Diagram of the Conductivity System.

Again, it is only within the last few years that instruments of the desired sensibility and construction could be obtained, owing to a lack of knowledge of the requirments of the art, and after these matters were partially cleared up the question arose as to whether or not a wireless telephone would have a commercial value, and like many other evolutionary devices there are to-day many engineers who can not see in it the importance attached to it by its inventor. While this is discouraging in the extreme, work has been carried on for the past three years in order to demonstrate to the technician and layman alike that it has a special sphere of action, and this happy day does not seem to be very far distant. It may be argued by some that wireless telephony had been accomplished by others and this is admitted, but before describing the theory and system devised by me let us cast a retrospective glance at the several other methods by which this may be accomplished.

The best known method for transmitting energy to a distance by the natural medium is by the conductivity system and has been in vogue for nearly 100 years; as early as 1825 James Brown Lindsay telegraphed across the River Dee in Scotland. Morse received it in this country in 1842; and by substituting a telephone transmitter and a receiver for the ordinary key and galvanometer or sounder, articulate speech may be carried on.

This is done by arranging four metal plates in parallel, as shown in the diagram, Fig. 1, where AB are connected with a transmitter and battery in series with CD, while the distance between AC and BD represents the distance over which speech or signals are to be sent without wires.

By this method Preece, of England, succeeded in transmitting speech eight miles without connecting wires, but, see now, the conditions which made this experiment possible was a length of wire twenty-five miles long joining AB and CD, so that as far as a commercial wireless telephone was concerned, the imitations began before the practicability of the scheme commenced. Mons. Moche, in his recent experiments at Monte Carlo, and Mons. E. Ducretet, in his tests with wireless telephony at the Catacombs, employed this method.

There is another and far more ideal method for transmitting speech without wires than the one described and in which no earthed connections are used; this is the inductivity method. Preece advocated it for space telegraphy, and by careful deductions it was believed possible to transmit signals— not speech — across the Atlantic Ocean provided a coil of wire large enough to include the whole area of England were suspended on poles, and to include the state of New York within a similar coil, but some exceedingly pretty experiments may be performed in wireless telephony with two coils of wire, represented in Fig. 2, by the side elevation AB, having a considerable diameter and arranged parallel with each other not too many feet apart.

When an intermittent or an undulatory current flows though the coil A, the magnetic lines of force emanate at right angles to the coils themselves, and some of these lines thread through the coil B, setting up currents of the same frequency and amplitude, though the impressed potential and current strength will be, of course, much smaller than the emitted, following the well known law of induction.

Alexander Graham Bell ascertained several years ago that the human voice could be reproduced with exactness by varying the intensity of a ray of light; this was done by causing it to fall on a concave mirror of small diameter attached to the diaphragm of a telephone transmitter, and then, by a series of lenes, concentrating the light and projecting it to a given point where the impinging waves acted on a selenium cell, and this gave rise to varying currents in a local circuit, including a telephone receiver.

Ruhner, of Germany, has improved upon the radiophone to such an extent that he is enabled to send wireless telephone messages a distance of four miles, but the enormous size of the equipment required, and the fact that propagation is impossible unless the transmitter and receiver are in a direct visual line having no intervening obstruction, render it of little more value than the interest attached to it from a scientific standpoint.

Since light waves utilized in the Bell radiophone are of the order of trillions per second it would not seem, on the face of it, to be a very hard proposition to employ Hertzian waves of the order of millions per second, for light waves and electric waves are both transverse vibration and travel with the same rapidity. But theory and experiments have shown wireless telephony to be exceedingly difficult by the Hertzian wave method; this is due to the gradually decreasing maximum of an oscillatory discharge, whereas a pure sine wave is required, and, again, that the oscillations of current are in phase with the vibrations of the diaphragm, the circuit which emits the waves must be slowed down by the addition of capacity and its relation to inductance sustained by the proper coils, when the telephone receiver will respond directly to the waves without a special wire detector in connection with it. Professor Fessenden and the author have both experimented with this form of wireless telephone, and the results are exceedingly interesting from a scientific viewpoint.

Having tested all the above principles to find the one best adapted to wireless telephony, I found a method for obviating the difficulties encountered in utilizing such rapid oscillations as the disruptive discharge of an induction coil produces and without employing condensers or coils for obtaining reasonance in the circuits, but by simple transformation only.

In experimenting with electric waves when employing a coherer adjusted to its maximum sensitiveness I have frequently found that a difference of potential occurs sufficiently great to break down its resistance, when low-frequency, high potential currents surge through the arms of the oscillator system and emit exceedingly long electric waves. The emitted and propagated waves are of necessity long, for the wave length depends on the rate of alternation or period of oscillation, as the case may be, and these reversals of current are bound by the co-efficients of the circuit—inductance, capacity and resistance—and finally these are governed by laws relating to the other.

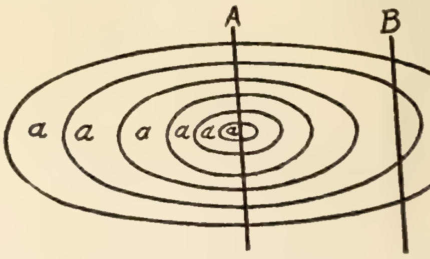


Fig. 2.—Diagram of Inductivity System.—A B Parallel Coils of Wire; a a a a a a Magnetic Lines of Force.

In my system of wireless telephony the discharge of low-frequency, high potential currents is permitted to restore the electrical equilibrium or zero potential in the earth, that is to say, the discharge takes place in the earth, in contradistinction to a disruptive discharge which occurs in free air, and the former produces some phenomena which seem to me to be new.

For instance, the proper inertia for the propagation of electric waves seems to depend largely upon the length of the wave which passes though it. Light waves being exceedingly short find in clouds an obstacle, though red light waves will penetrate fog much more easily than the shorter ones of blue or green because they are longer. Marconi has observed that electric waves, a kilometre or more in length, penetrate fogs with apparent little loss of energy, and the evidence at hand tends to prove that long electric waves will traverse gross matter, like the earth, much more easily than they will free air.

This may be attributed to the apparent modification of ether when related to gross matter, for it is generally accepted that the density of ether when closely allied with an atom of matter is greater than ether in vacua, and the density of the ether surrounding the atoms of which the earth is composed renders it especially conductive to the emitted waves of my wireless telephone transmitter, and the experiments I have made fulfill the requirements of this theory quite nicely.

As an analogue we have in the realm of sound an experiment which will serve to make it clearer. A good many years ago, it may be remembered by some, when it was our wont to go to the "ole swimmin' hole," we would perform a little feat in physics by striking two stones together in the water and the clicking would be heard many times farther and much more distinctly than when struck in free air, for dense mediums transmit sound waves to greater distance than those less dense. On this principle the late Professor Elisha Gray devised his submarine signaling bell.

In a homogeneous medium, such as water, the bound ether will transmit long electric waves farther, better and with less distortion than in a heterogeneous medium such as the earth itself, and so water becomes the best medium for wireless telephony as well as for wireless telegraphy. But wireless telephony is by no means confined to water, and until recently all the experiments and tests were made on hilly lands.

An illustration of my wireless telephone mounted for field work is given in Fig. 3. It includes a transmitter and a receiver. The primary of the sending induction coil is in series with the transmitter, battery, variator and key. The terminals of the transformer are connected to the earth and a compensating capacity. Bridged across the terminals of the secondary is a Leyden jar condenser. The receiver is formed of a closed circuit having the telephone receiver, a single dry cell and the secondary of a transformer in series. The primary of the transformer is earthed as in the case of the transmitting secondary of the induction coil.

In ordinary practice the waves are radiated in every direction, but it has been found possible to direct them within ten or fifteen degrees of arc. Fig. 4 shows how the earth plate is placed.

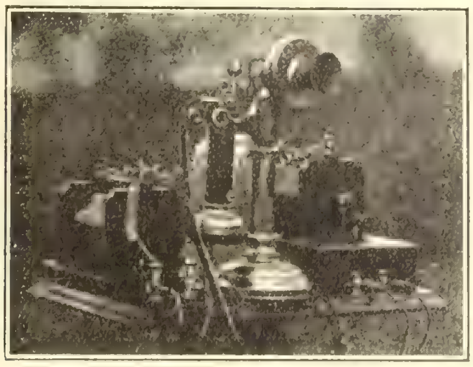


FIG. 3.—WIRELESS TELEPHONE PORTABLE TRANSMITTER AND RECEIVER.

My experiments in wireless telephony were begun in Philadelphia in the fall of 1899, and in 1900 I sent and reproduced speech electrically through the earth a distance of 200 feet. Narberth, Pa., was then selected as a desirable place for testing stations, and in 1901 apparatus was constructed and tried across the Delaware river at a distance of a mile, and in 1902 this was extended to three miles ; the instruments were located on two hills, with a valley, stream, quarry, railroad, telephone and telegraph wires intervening. The reproduced voice was faint, but the articulation was not distorted.

At the present time experiments are being made constantly at Rockford Lake, N.Y., and while it has not been attempted to increase the distance cited above, the instruments have been wonderfully improved with the result that the articulation is clear and loud enough for commercial purposes.

Another feature that has been added in the way of making the system commercial are bells at both stations which are operated wirelessly, and I believe that this is the first complete wireless telephone equipment constructed, operating in both directions, together with signalling apparatus.

The value of wireless telephony lies in its application to speech transmission between vessels, supplanting the time-honored and hoary steam whistle. It may be used in isolated cases where bodies of water intervene and where cables would prove too expensive. It may be used where the right of way can not be obtained for erecting poles or stringing wires ; there are a thousand places where it will be welcomed, but as a block signal system for vessels in harbors it will, in my opinion, find its proper sphere of usefulness.

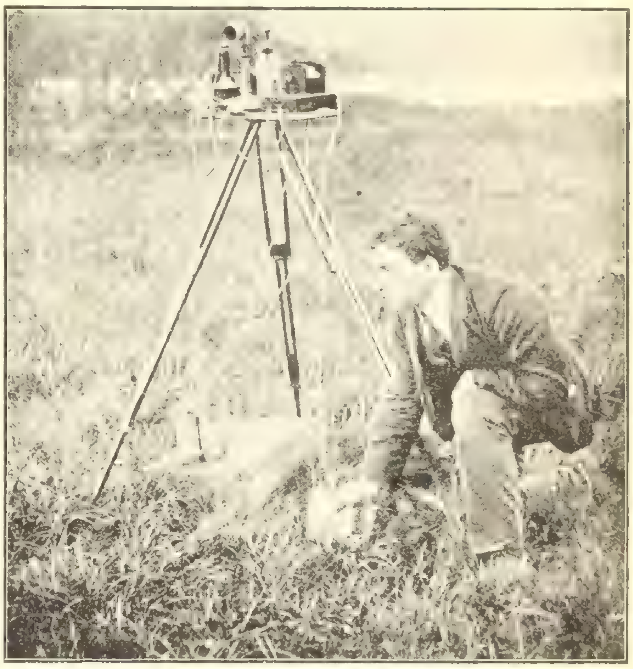


FIG. 4.—WIRELESS TELEPHONE FIELD EQUIPMENT.—PLACING THE EARTH PLATE.

My wireless telephone may never supplant the wire system now in use, but it can to-day be employed where the wire telephone can not be used— on the water and other inaccessible places. Nearly all wrecks are the result of colliding vessels in harbors, due to a misunderstood signal. But when these vessels are equipped with my system—as I hope they may all be soon —the captains will be placed in the same relative position as the modern business man, and they will be able to communicate with each other while sitting in their cabins or from the bridge, instead of relying on a system of signaling that should be relegated to the dead past.— Electrical Review.

SHORT-CIRCUITS.

The People's Telephone Company, of Sherbrooke, Que., purpose improving their system.

Long distance teleohone communication has been established between Winnipeg, Man., and St. Paul, Minn.

Local capitalists at Vancouver, B.C., represented by Mr. D. G. Macdonell, are forming a company for the purpose of installing and operating a new telephone exchange independent of the New Westminster & Burrard Inlet Telephone Company.

The semi-annual meeting of the New Brunswick Telephone Company was held at Fredericton on December 9th, when a quarterly dividend of 1¼ per cent. was declared. During the last six months the company made a large expenditure in building and equipping a new telephone exchange in St. John.

Mr. W. A. Green, local manager of the Bell Telephone Company, at Berlin, Ont., died on December 10th in Toronto, where he was visiting a friend. Mr. Green had been in poor health for some time. He was born in England 57 years ago, being the son of the late William Green, of Chantry, Somersetshire. He assumed charge of the Berlin office of the Bell Telephone Company about four years ago.

COMPARISON OF COMPRESSED AIR WITH STEAM AND ELECTRICITY AT ROSSLAND, B.C.[*]

By William Thompson.

Compressed air has become so generally used in connection with mining operations, and so well recognized as the most useful and economical power, with its unlimited range of uses, and special adaptability to underground work, that an introductory to this paper on the subject would be superfluous to mining engineers.

The comparative economy of prime movers for air compressing engines is, however, of great interest to all, and a subject on which any engineer can read with interest. This is particularly the case with engineers practising in British Columbia, where a large number of the mining problems include the extraction and reduction of large bodies of low-grade ores and the consequent necessity for a thorough study of economical methods for mechanical handling.

The general mobility of compressed air as a power allows a wide range of generators, or prime movers, but we can, in nearly all cases, rely upon having to adopt primarily one of two sources of power, viz., water or heat.

Water, the first of these, can, as we know, be used in many ways, each terminating finally at the mine, as compressed air ready for service. The initial water power may come from one or more sources situate either at the mines or many miles distant, and can be used either as a directly connected unit of power for the compression of air, or as a prime mover for some intermediary power.

British Columbia has been fortunately blessed with magnificent water powers, more particularly in the Kootenays. In many cases these water powers are situated close to the mines; in others, as at Rossland, they are several miles away.

Distances over which power can be economically transmitted by electricity are yearly becoming greater until it seems that distance is no longer an obstacle, and it has become simply a question of capital investment to successfully transmit the power generated by water almost any distance.

Heat, the second great source of power for the generation of compressed air, has been successfully used as steam for many years, even in places which seemed to be utterly inaccessible either for the erection of the necessary machinery, or the securing of fuel after the machinery had been installed and made ready for operation. So accustomed have we become to surmounting difficulties of this kind, that we are apt to look with suspicion upon any suggestion to utilize distant water powers, preferring to resort to steam as being the power we best understand, and one which has been successfully installed and economically operated under very adverse circumstances.

British Columbia has been abundantly provided with fuel, in fact, we can say the supply of coal is practically unlimited. Enterprising capitalists, year after year, extend railways between the coal fields and the consumers, so that no producing or promising mining district has long to wait for an unlimited supply of this fuel. The mines at Rossland are exceptionally favored in this respect, all the leading mines having access to two lines of railways, and, through them, the coal fields of both British Columbia and the State of Washington.

Rossland is also favored by having the immense water power at Bonnington Falls, less than 40 miles distant, immediately available. The enterprise of Sir Charles Ross and associates in the West Kootenay Power & Light Company have rendered this available for any service at each mine, as a competitor of the steam power, which mine managers would otherwise be compelled to adopt.

The question of the selection of power supply to be made by mine managers at Rossland is almost entirely removed from chance, and may be based on ascertained facts. Railways being at hand for the transportation of any kind of machinery, reasonably cheap fuel in quantities required is assured, and electric power for any size machinery or service is available. Therefore the problem simply resolves itself into "which of these powers will give the best service in operating the machinery used in connection with mining operations?"

The same privilege applies to nearly every other mining district in Southern British Columbia; therefore, the writer feels that the results obtained in the air compressing plants at Rossland will be of special interest to the members of the British Columbia section of the Canadian Mining Institute and mining engineers.

The steam and electric plant described further on were modelled on the design and erected under the personal supervision of Mr. Bernard Macdonald, then general manager of the Le Roi and Nickel Plate mines, assisted by the writer. The steam plant was erected for the Le Roi Mining Company, Limited, and consists of the following, viz.:

Boiler Plants.— Two 250 horse-power Heine safety water tube boilers, arranged to burn coal as fuel. These were intended to generate steam to run the air compressors, and were set so as to work, if desirable, in connection with the 125 horse-power steel shell return tubular boilers, designed to operate the hoisting and surface plants. These boilers are arranged to be interchangeable to either service. A general description of this plant will be found in volume V., page 309, of the Journal of the Canadian Mining Institute.

During the test, the water-tube boilers were used at a gauge pressure of 150 pounds per square inch, using Crows Nest coal as fuel, which cost, laid down in front of the boilers, $5.55 per ton of 2,000 pounds.

Air Compressing Plant.—The steam driven plant consisted of two compound condensing Corliss valve engines, direct connected to two stage air cylinders, equipped with intermediate cooling devices, each machine having a rated capacity of 4000 cubic feet of free air per minute, or a combined capacity of 8000 cubic feet of free air per minute at sea level.

A more detailed description of these engines would be as follows:

	No. 1 Engine. Inches.	No. 2 Engine. Inches.
Diameter high pressure steam cylinder	22	22
Diameter low pressure steam cylinder	36	36
Diameter high pressure air cylinder	22	22
Diameter low pressure air cylinder	36	38
Length of stroke	48	48

Intercoolers, horizontal multitubular type; condensors, independent jet.

The Electrically Driven Air Compressing Plant.—This plant was erected by the Rossland Great Western Mines, Limited, and was originally intended to be operated in connection with the steam plant previously described, the intention being to supply power from a central station to four mines, owned by different companies. This arrangement would have given each mine power at the lowest possible cost, and have ensured continuous operations by reason of the compressing plant being arranged in separate units. Each company would pay its share of operation, maintenance of plant, pro rata to its consumption of air.

When it was found necessary to erect the third unit to the compressing plant, unforeseen difficulties presented themselves in the shape of shortage of water for condensing and cooling purposes. On examination, it was found that a satisfactory supply could not be secured without heavy capital expenditures for erection of flumes, etc., to convey the water to where it was required for use.

It was, however, found that a supply of water, barely sufficient for the intercoolers and waterjackets, was available about three-fourths of a mile distant from the steam plant. This supply was so located that it must be either pumped or else the plant located at this distance away from the main steam plant. By conserving this water supply, cooling and re-using, it was decided a sufficient supply of water for the air cylinder jackets and intercoolers could be secured.

The results obtained from the steam plant had proven so satisfactory that it was considered questionable if any electric plant could be installed that could successfully compete with steam, even when running non-condensing, unless very favorable rates for power could be secured. After negotiations with the power company it was decided to erect an electrically driven plant, a short description of which is as follows:

Electrical Equipment. —Three phase, S.K.C., synchronous motor, designed for 2200 volts, with a rated capacity of 660 kilowatts, equivalent to about 825 horse-power. The motor is provided with a separate starting motor, mounted on the main frame, exciter and Italian marble switch-board, on which all operating switches and instruments are mounted.

There is a 54 inch Frisbee clutch set intermediate between the driving pulley and the motor. The motor is of a four bearing type, fitted with self-aligning and self-oiling sleeves. The entire machine is mounted upon a solid cast iron base set upon massive concrete foundations. The driving pulley is 60 inches in diameter, grooved for 22 1½ in. ropes, and runs at 270 revolutions per minute.

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[*] Paper read at the Nelson meeting of The Canadian Mining Institute.

The three compressors were built by the Canadian Rand Drill Company, of Sherbrooke, Quebec, and are especially designed for constant service.

The electrical equipment is also entirely of Canadian manufacture, the entire apparatus being manufactured by the Royal Electric Company, of Montreal, who were the Canadian manufacturers of the S.K.C. apparatus.

All tests were conducted under the personal supervision of the writer, and extreme care was taken to arrive at actual facts. Indicator diagrams were take off both the steam and air cylinders every half-hour, and the results tabulated. Coal consumed was weighed, and all other supplies, such as waste, oil, etc., charged as used.

Readings were also taken and recorded by means of a delicately adjusted kilowatt meter, connected to the primary mains, of the amount of electric power used. The test extended over a period of thirty days, without interruption, both plants being run under exactly similar conditions as to air pressure.

Each of the plants tested being modern and representative of their respective types, gave an opportunity for a comparative test that rarely falls to the lot of an individual engineer under such favorable conditions, as to work being performed, and for this reason is the more valuable as data for basing calculations as to problems of power.

The average results of the thirty days' test is recorded in tables I, II, III, IV and V following:—

TABLE I.

Work Performed by Steam Plant.

Average indicated horse-power at steam cylinders of the combined machines	730 h.p.
Free air compressed per minute from atmospheric pressure to 95 lbs. per square inch	5432 cu. ft.
Free air compressed per hour	325,920 cu. ft.
Average horse-power required at steam cylinders to compress 100 cubic feet of air per minute, to gauge pressure	13.4 h.p.
Pounds of coal consumed during test	1,038,000 lbs.
Pounds of coal consumed per day of 24 hours	36,400 lbs.
Average pounds of coal consumed per horse-power per hour during test	1.9 lbs.

TABLE II.

Work Performed by Electric Plant.

Average horse-power registered at switch-board	540 h.p.
Free air compressed per minute from atmospheric pressure to 95 pounds gauge pressure	3,319 cu. ft.
Free air compressed per hour	199,140 cu. ft.
Average horse-power required at motor to compress 100 cubic feet of free air per minute to 95 lbs. gauge pressure	16.3 h.p.

TABLE III.

Cost of Operating Steam Plant.

Total cost of fuel consumed during test	$2,880.45	
Total cost of wages for employees	710.00	
Total cost of oil, waste, etc	147.30	
Total cost for 30 days, exclusive of maintenance and depreciation		$3,737.75
Cost per horse-power per month for fuel	3.96	
Cost per h.p. per month for oil, etc	0.20	
Cost per h.p. per month for wages	0.97	
		$5.15
Cost per h.p. per annum		$61.56
Cost for each 100,000 cubic feet of free air compressed		1.56
Cost per drill shift		1.25

Note.—80,000 cubic feet taken as the average consumption per shift of one 3¼ in. drill.

TABLE IV.

Cost of Operating Electric Plant.

Cost of current for 30 days	$1,744.26	
Cost of employes' wages	270.00	
Cost of oils, waste, etc	73.00	
Total cost for 30 days exclusive of maintenance and depreciation		$2,087.86
Average cost per horse-power per month		3.87
Average cost per horse-power per annum		46.44
Cost for each 100,000 cubic feet of air compressed		1.46
Cost per drill shift		1.17

Note.—80,000 cubic feet taken as the average consumption per shift of one 3¼ in. drill.

TABLE V.

Showing comparative results between the two types of compressors, based on each 100,000 cubic feet of air compressed from atmospheric pressure to 95 lbs. receiver pressure :

Cost for each 100,000 cubic feet of free air compressed by steam plant (see Table III)	$1.56
Cost for each 100,000 cubic feet of free air compressed by electric plant (see Table IV)	1.46
Result, saving by electricity over steam	6.4 per cent.

The saving shown in Table V would be affected adversely if the electric plant was operated singly and the entire air compressed was not used, for the reason that electrically driven compressors must be operated at constant speed, and loss of air at safety valve would be considerably increased over the same loss at steam plant, which could be run at the speed required to compress the amount of air actually required. This loss would, however, be slightly off-set by the increased cost per horse power by working the steam compressors on underload.

I wish to draw special attention to the noteworthy results obtained from the system of intercooling used on the compressors tested.

In Table I it is shown that the steam plant required 13.4 horse power to compress 100 cubic feet of air to 95 pounds gauge pressure per minute. The best power factor recorded that has come under the writer's notice, for doing the same amount of work by a two stage compressor, is 14.5 horse power, which shows a saving of 8 per cent. resulting from the use of specially designed intercoolers, for which the manufacturers are entitled to receive the credit.

How this result is obtained can be best understood by reproducing the average of a number of tests made on the efficiency of the intercooler during the progress of the power test. The results of these tests are shown in Table VI.

TABLE VI.

Temperature of cooling water at inlet of intercooler	42 deg. F.
Temperature of cooling water at outlet of intercooler	50 deg. F.
Rise in temperature of cooling water while passing through intercooler	8 deg. F.
Temperature of air at outlet of low pressure cylinder and before passing through intercooler	196 deg. F.
Temperature of air at inlet of high pressure cylinder after passing through intercooler	54 deg. F.
Reduction in temperature of air after passing through intercooler	142 deg. F.

In conclusion, permit me to state that this paper has not been prepared with the idea of recording the performance of these two plants, except in so far as comparisons can be drawn between the relative efficiency of the two systems, so that engineers, knowing local conditions, can have some record of actual performance before them.

MOONLIGHT SCHEDULE FOR FEBRUARY.

Day of Month.	Light.		Extinguish.		No. of. Hours
		H.M.		H.M.	H.M.
1....	P.M.	5.40	P.M.	6.15	12.35
2 ..	″	5.40	″	6.15	12.35
3....	″	5.40		6.15	12.35
4....		11.00	″	6.15	7.15
6...	″	0.15	″	6.15	6.00
7..	″	1.15	″	6.15	5.00
8....	″	2.15	″	6.15	4.00
9 .	″	3.00	″	6.15	3.15
10....	″	4.00	″	6.15	2.15
11 ...	No Light.		No Light.		.
12....					..
13....	A.M.	6.00	A.M.	9.15	3.15
14....	″	6.00	″	10.30	4.30
15....	″	6.00	″	11.30	5.30
16..	″	6.00		12.30	6.30
17 ..		6.00	″	1.30	7.30
18...		6.00	″	2.30	8.30
19		6.00	″	3.20	9.20
20..		6.10	″	4.10	10.00
21...		6.10	″	5.00	10.50
22....		6.10		5.45	11.35
23...		6.10		5.45	11.35
24...		6.10		5.45	11.35
25...		6.20		5.45	11.25
26...		6.20		5.45	11.25
27...		6.20	″	5.45	11.25
28...		6.20		5.45	11.25
			Total		211.50

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, January 8th, 1903.

The question of supplying heat has apparently been shelved for the present by two of the electric companies. The Standard Electric Company, which has been affiliated with the Lachine interest for some years, and which in consequence drives its d. c. power generators by means of a c. motors furnished with current from the latter company, thought that they might use to advantage their boilers standing idle, to do commercial heating. It seems that their charter from the legislature gives them (so they claim) the right to open up the streets to "pipe" for that purpose. The point was also quickly taken up by the Montreal Light, Heat and Power Company, who claim similar charter privileges, and who had the steam plant of the Royal Electric Company at their disposal, as the Chambly dam now delivers the necessary electric current. Accidents, however, have shelved matters, at least for the present, first owing to the price of coal as the result of the iniquitous coal strike, and secondly owing to a break in Chambly dam. The Montreal Light, Heat and Power Company have not only brought into requisition the steam plant of the Royal Electric Company at their disposal, but have leased for a time that of the Standard Company as well.

The dark mornings during the last month, coupled with dismal days and early evenings, must have caused abnormal bills for lighting, but if all the complaints re. electric meters were listened to, one would imagine that such a piece of apparatus is not yet manufactured that comes within 80 per cent. of being correct.

Rumors are again strong anent an amalgamation of the Lachine Rapids and Montreal Light, Heat and Power Companies. The advice of the old folks that two "heads" are better than one may be taken.

Strange how the press know so much about Marconi's successes or failures at Glace Bay, when it is a fact that no one except his own trusted operatives are allowed inside the works and no information has as yet been given. News "guessed at" is apt to look ridiculous in the future—especially is this so with regard to electrical inventions.

It is high time that a word of caution was given the public regarding the small lamps operated by batteries, and more especially by miniature dry cells which any one electrically versed knows are for open circuit work only. They may be meant to be "flashed" only, but the average purchaser does not do so, ruins his battery in no time, then rails at small electrical devices in general indiscriminately.

The fire at the residence of Mr. A. A. McKenzie, Sherbrooke street, which the press unitedly stated must have been caused by electric wires, is only one more of the usual. There was not one iota of proof or reason for laying the cause to electricity, and competent experts have put the blame on a grate in a room which was used pretty continually during the cold snap.

Query : Lots of soft coal is being consumed in Montreal this winter, and stoked by those paterfamilias who have been used to anthracite in the past. If electricity is to be blamed for all the fires this winter, it will undoubtedly be bearing the "white man's burden" with a vengeance.

DOMINION INSTITUTE OF AMALGAMATED ENGINEERING.

At a meeting of the Dominion Institute of Amalgamated Engineering held recently at the office of the Secretary, 32 Church Street, Toronto, the effect of two recent decisions, the one by the judicial committee of the Privy Council and the other by the Supreme Court of Canada, affecting the patent law of Canada, was under discussion, and the following resolution was unanimously adopted: That the Government be asked to repeal the present Patent Act and to substitute therefor an act similar to that of the patent law of the United States. A committee was appointed to take action in the direction of the legislation recommended by the meeting.

A PROGRESSIVE ELECTRIC COMPANY.

Gradually the electric railway is becoming a factor in the interstate traffic of passengers. With two or three changes it is now possible to go from Buffalo through portions of the states of New York and Pennsylvania, Ohio and Michigan, an almost continuous electric line around the south shore of Lake Erie to Port Huron. On some stretches of this route the cars run half-hourly, and all at least hourly. The best portion with the closest connections is between Port Huron and Detroit, the cars all being luxuriously fitted up with velvet plush covered seats. Everything appears up-to-date under the management of Mr. Wood.

The power houses along the route furnish an abundant supply of electric energy. At Port Huron the power is generated by the Port Huron Power & Light Company, of which Hon. Henry McMorran is president, Mr. W. F. Davidson (the well-known expert electrician) being secretary and treasurer, and Mr. James Davidson superintendent and manager.

Port Huron claims to be the very first place on this continent to run an electric railway, consequently one is partly prepared to see a good plant. The Port Huron Light & Power Company furnish 700 h.p. each to the Port Huron Mfg. Company and the Engine and Thresher Company, also to the street car lines, incandescent and arc-lighting plant.

This company were the first to establish enclosed arc-lights. The plant is of the 500 volt 3 phase system. They can step up to 10,000 volts and step down to 200 volts, using 3 phase alternating induction machines. The whole plant is one the neatest and cleanest in America. The company are now building an exact duplicate plant to increase their present capacity. The new 2,000 h.p. turbine will be directly connected with a 500 kilowatt, 3-phase, 60 cycle, 1100 volt G.E. generator. In this plant are also the following : Two 500 kilo-watt direct current generators of the Westinghouse type (for street car service) ; two 300 kilo-watt, 60 cycle, 1100 volt, 3-phase G.E. machines ; two 120 light Brush arcs ; six T.H. 50-light arc machines ; two 62-kilowatt 500 volt D.C. generators ; one 500 h.p. Westinghouse compound engine ; one 500 h. p. Ball engine, cross compound ; one 1000 h.p. Russell tanden compound ; three double battery 500h.p. Sterling boilers, and one 250 h.p. same make. The new plant now going in will just double the above.

The condensing sett consists of rotating water pumps, air pumps and small pumps to take care of the overflow from the hot well, all of the Alberger type. The condensing outfit must maintain 28 inches vaccum, and was built expressly for the Port Huron Compony.

IMPORTS OF ELECTRICAL APPARATUS.

According to the trade and navigation returns, the value of electrical apparatus imported into Canada during the fiscal year ending June 30th, 1902, was $1,373,022, an increase over the preceeding year of $453,168. The duty paid thereon was 25 per cent. on generators, motors, batteries, telephone and telegraph instruments, etc., 15 per cent. on carbons over six inches in circumference, and 35 per cent. on carbons of smaller dimensions. The details are as follows:

Generators, motors, and sockets—from Great Britain, $2,422; United States, $330,492.

Electrical apparatus not elsewhere specified — from Great Britain, $12,470; Newfoundland, $15; Austria-Hungary, $49; Denmark, $24; France, $177; Germany, $2,758; United States, $918,637.

Electric light carbons over 6 inches in circumference—from France, $153; United States, $47,933.

Electric light carbons and carbon points, of all kinds, not elsewhere specified — from Great Britain, $296; France, $10; Germany, $3,456; United States, $25,360.

Telephone and telegraph instruments — from Great Britain, $557; France, $130; United States, $28,083.

The Commercial and Financial World, of New York, states that Judge Coxe, of the United States Circuit Court, has granted a perpetual injunction against the Keystone Electrical Instrument Company restraining the latter from manufacturing and selling electrical measuring instruments claimed to be an infringment upon the Weston instruments. The essence of the decision is that the Weston Electrical Implement Company have the sole right to manufacture alternating current measuring instruments based on the dynamometer principle.

SPARKS.

Mr. W. Pullman, of Sturgeon Falls, Ont., has been appointed chief electrician of the new municipal power plant at Vernon, B.C.

The Westinghouse Electric & Manufacturing Company, of Pittsburg, are establishing a factory in Ottawa for cutting and preparing mica for use in the electrical business.

The ratepayers of Guelph, Ont., voted on a by-law in January authorizing the council to purchase the plants of the Guelph Light & Power Company at a valuation of $155,000.

The warehouse of the Canadian General Electric Company at Toronto was closed for regular business from January 2nd to 6th, for the purpose of stock-taking. The company issued a circular making the announcement and thanking their customers for past patronage.

The annual meeting of the Sherbrooke Street Railway Company was held last month, and at a subsequent meeting of the directors Mr. J. W. Burke was re-elected president, Mr. P. W. Clement vice president, and Mr. R. Denio secretary and general manager.

The citizens of Fort William, Ont., have become impatient on account of the delay on the part of Mr. E. S. Jenison in developing the Kakabeka water power, and at a recent meeting of the council it was resolved to take steps to develop the Ecarte Rapids or Kakabeka power.

Mr. E. S. Harrison, manager of the Suburban Rapid Transit Company, of Winnipeg, states that the road from the city limits to Sturgeon Creek will be completed in the spring, and that if satisfactory arrangements cannot be made for an ample supply of power, the company will build their own power house.

The St. George Pulp & Paper Company, of which Mr. E. G. Murphy is general manager, are developing 4,500 horse power on the Magaguadavic river at St. George, N. B., the intention being to build a pulp mill. They have awarded to the Jenckes Machine Company, of Sherbrooke, Que., the contract for two pairs of 45 inch special Crocker turbines and two pairs of 20 inch special Crocker turbines, all in steel cases, arranged for horizontal setting and capable of developing 2,568 horse power under 40 feet effective head of water. The water is carried through a steel plate riveted pipe 16 inches in diameter and 450 feet long, also supplied by the Jenckes Company. This penstock was punched, rolled, fitted together and painted at their works before shipment. It is also intended to install an electric lighting plant, which will be supplied by the Westinghouse Electric & Manufacturing Company, of Pittsburg.

Attention is directed to the advertisement in this issue for a competent man to take charge of the operating department of a telephone system. Any of our readers desiring a position of this kind may obtain particulars by applying at this office.

The McGraw Publishing Company, 114 Liberty street, New York, have just published a valuable book entitled "The Art of Illumination," the author being Louis Bell, Ph. D. It is the only book in the language which deals directly with the scientific and artistic use of modern illuminants, electric and other. The chapters upon electric incandescent lamps and arc lamps are especially rich in practical information regarding their economical and artistic use. There are 127 illustrations, and bound in cloth the book sells at $2.50.

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The "Triton" Marine Gasoline Motors are manufactured by a firm which has made a specialty of Marine Gasoline Engines for years, and they are the

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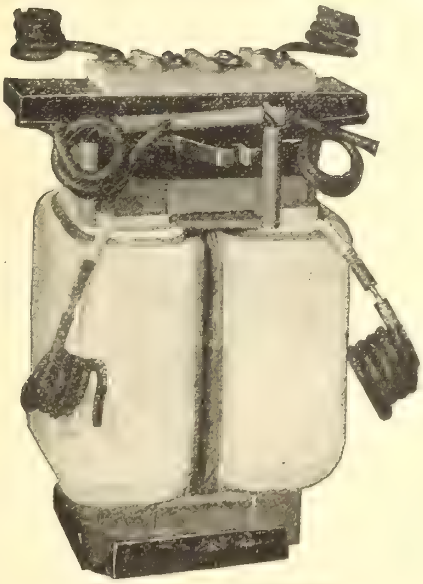

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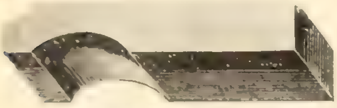
Toronto, Ont.

SPARKS.

The Eastern Telephone Company, of Sydney, N. S., have declared a regular half-yearly dividend of three per cent. for the six months ending November 30th, 1902.

The Toronto Electric Light Company have about reached the limit of the capacity of their present works, and have had specifications prepared for an additional engine of 1,000 horse power and other equipment, which will enable them to cope with the steadily increasing demand for light and power. Two or three years will probably be required to develop and put in operation the Niagara Falls transmission system, and the increase in the company's business is such that the completion of this system cannot be waited for. Even after it is completed, it will be necessary to have in reserve a steam plant capable of doing the work in case of accident. This has been found necessary in Montreal and Hamilton, also in Belleville, where a steam plant is now being installed, the water power at Trenton having recently been temporarily disabled by an accumulation of anchor ice which clogged up and rendered inoperative the water wheels. The city of Belleville was, in consequence, without light for several days, until, by means of dynamite, the blockade was removed.

SWEDISH CHARCOAL IRON SHEETS, BARS, RODS, STRIPS AND STAMPINGS.



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Discs over 5 feet diameter and Plain Circles
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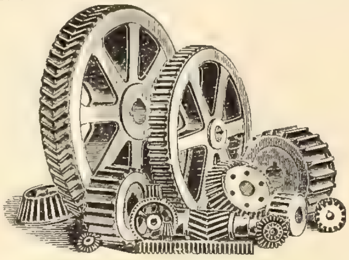

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WANTED

By young man well recommended a position as constructing or operating superintendent, eight year's experience, up-to-date on contracts, etc. Apply Box 65, care of CANADIAN ELECTRICAL NEWS, Toronto.

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The following vols. of Hawkins' Works for sale :—New Catechism of the Steam Engine ; Instructions for the Boiler Room ; Hand Book of Calculations ; Practical Treatise on the Steam Engine Indicator. Apply to DAVID PITCEATHLY, Fenelon Falls, Ont.

Telephone Lineman Wanted

to take charge of the operation of a small town exchange west of Winnipeg, about two hundred telephones; must be thoroughly acquainted with construction work and have expert knowledge of Switch Boards and Telephones Apply at the office of the ELECTRICAL NEWS, Confederation Life Building, Toronto, giving experience, references and salary expected.

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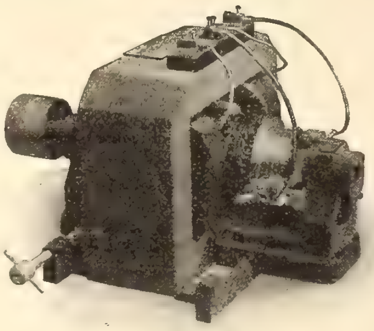

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Western Telephone Manufacturing Company

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SPARKS.

The Bell Telephone Company of Canada have recently completed a copper line between Montreal and Quebec, the weight of which is 260 pounds per mile. This line provides perfect service with places as far distant as New York and Philadelphia.

The Guelph Street Railway is reported to have passed into the hands of a new company, with Mr. A. F. H. Jones as president. Mr. William H. Brown, for some years with the Metropolitan Railway, North Toronto, has been appointed manager and superintendent.

Marconi has announced the successful transmission of a wireless message from Glace Bay, Cape Breton, to Cornwall, England. A message has also been transmitted to the London Times, in the presence of Dr. Parkin, who is the Times special correspondent. The messages were sent and received by the first long distance wireless telegraph apparatus ever made.

The arbitration at Midland, Ont., to determine the value of the electric plant of the Midland Electric Company has been concluded. H. F. Strickland, E.E., was expert for the company and Mr. H. J. Hurd for the town. The town offered $8,000 for the plant, whereas the company ask $19,000, which is believed to be much nearer the actual value. The arbitrators were Judge McCrimmon, Judge Ardagh and Mr. Creswick, of Barrie. It is understood that the town endeavored to value everything comprising the plant as scrap.

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ALL DESIGNS
Get Catalogue.
CANADA METAL CO.
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Persons desiring to obtain a city, state, or government license, to operate a steam plant, will find "The Hawkins' Engineers Series" valuable assistance, both for study and reference.

The library consists of seven volumes, sold for $12 on monthly payments of one dollar.

A complete catalog and description of the books sent on application.

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The address is 168, Fleet, London, Eng.

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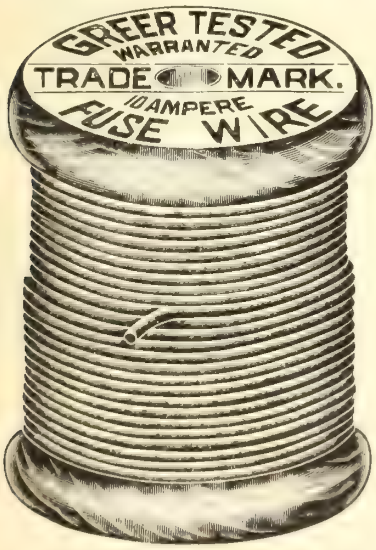

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Full weight guaranteed to each spool. Warranted to be absolutely uniform, reliable and accurate. Send for catalog.
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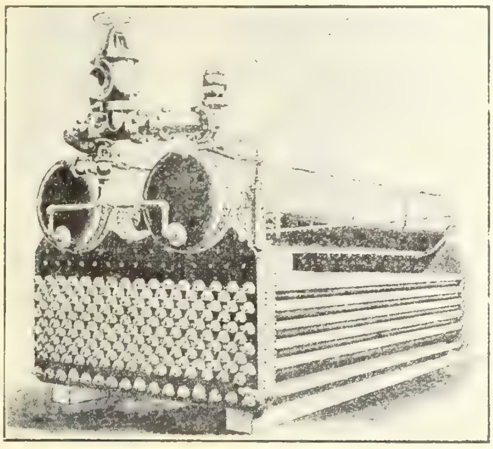

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HIGH CLASS
Water Tube Steam Boilers
for all pressures, duties and fuel. From 75 to 600 h. p. each. N. B.—We do not make small boilers.
REFERENCES :— The Toronto Electric Light Co , Limited ; The T Eaton Co., Limited ; The Massey-Harris Co., Limited, The Gutta Percha Rubber & Mfg. Co., Dominion Radiator Co., Central Prison, Foresters' Temple, Toronto City Hall, where boilers may be seen working.

RECENTLY PUBLISHED
THE CANADIAN HAND-BOOK OF STEAM AND ELECTRICITY
BY WILLIAM THOMPSON
170 Pages, Illustrated In Strong Cloth Binding

THE preparatory chapters are devoted to a concise explanation of the foundation principles of Mathematics, a knowledge of which is absolutely necessary to the study of Electricity and Engineering. In the succeeding chapters the student is led by gradual stages to a more complete acquaintance with these subjects, and is equipped with knowledge to enable him to pursue his researches to any further extent.

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SPARKS.

Messrs. Brombey & McGregor, manufacturers electrical supplies, Montreal, have registered partnership.

The Ottawa Electric Railway Company have adopted a new style of transfer similar to that in use in the largest cities in Canada.

Mr. J. S. Clark has submitted a proposition to the city council of Guelph, Ont., for the extension of the Guelph street railway to Hespeler.

The Ernest S. Harrison Company, Limited, has been organized at Winnipeg, Man., with a capital stock of $100,000. The promoters are Messrs. E. S. Harrison, M. Harrison, T. H. Webb, J.H. Machray and F.J. Sharpe.

Mr. Clarence Thomson recently delivered an interesting lecture on "The Use of Electricity" before the Montreal Women's Club. He treated the subject more particularly with regard to electric lighting and illustrated some of the past and present methods of obtaining light. He was assisted in the experiments by his father, Mr. Fred Thomson.

Mr. Thomas Bagley, of Toronto, was killed at Grand Forks, B C., by a live wire under peculiar circumstances. He slipped while standing on an elevated platform and in falling, grabbed the telephone wire, thus receiving a fatal shock. The mysterious part of the affair is the circumstance that the wire did not cross, and was at least fifteen feet from the wires of the power line, which carries 20,000 volts. The assumption is that the accident was due to induction.

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In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

MESSRS. FRED. THOMSON & CO.

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have arranged their works for repair work only. They keep armatures of nearly all makes of dynamos in stock, which they loan while repairs are being made. Their factory is so arranged that they can run night and day, and work can be finished in the shortest possible time. Telephone Main 3149.

FOR SALE.

The rights to manufacture the Hooper Magnetic Electric Brake will be sold at a reasonable figure. The patents are also for sale. Offers from companies for local or state rights solicited.

This Brake is considered by experts the best ever invented. It has been successfully tried and thoroughly tested.

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THE "RADIANT SHELBY"
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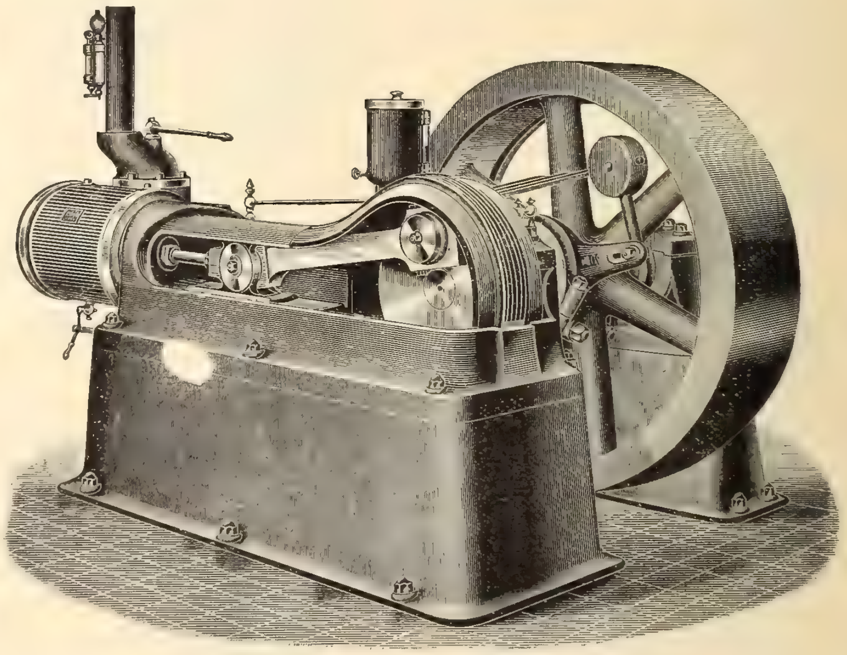

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SPARKS.

The ratepayers of Strathroy, Ont., have voted in favor of assuming control of the electric light plant.

The Arnprior Electric Light Company, of Arnprior, Ont., propose to bring power from Pakenham, about ten miles distant.

Canadian Motors Limited, manufacturers of electric automobiles, Toronto, has been absorbed by the Canada Cycle & Motor Company.

The Ontario Power Company have submitted to the Department of Railways and Canals, Ottawa, plans of their proposed transmission line to Toronto.

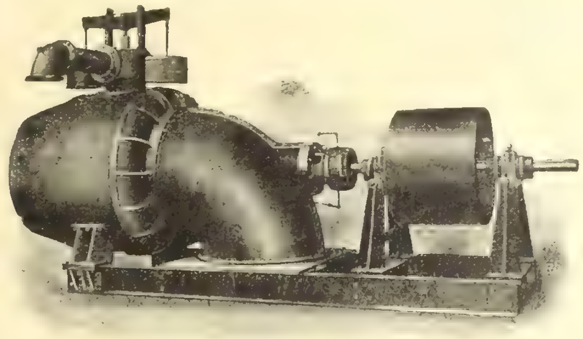
Mr. Charles Mills, architect, of Hamilton, is said to be forming a company for the purpose of supplying light and heat to the business places in that city bounded by King, James, King William and Hughson streets.

Mr. Theodore Charette has been appointed superintendent of the new waterworks and electric lighting systems at Gatineau Point, Que.

The Niagara-Welland Power Company is applying to the Dominion Government for permission to increase its capital stock and for an extension of the time for completion of the proposed work.s

The Cataract Auxiliary Company has been incorporated by the gentlemen concerned in the Cataract Power Company, of Hamilton. The auxiliary company will own and control the auxiliary steam plant recently installed and its further purpose is to have control of other arrangements of power installations within the city. The company have recently been given a large contract for electrical power by the Deering Harvester Company, as the result of which the capacity of the power plant at Decew Falls will be increased.

A Single 27 inch
Victor Turbine
On horizontal shaft is shown by the cut herewith. The water is discharged through one end through the draft tube, and in this case the usual end thrust connected with single wheels is entirely provided for.
The Victor Turbine is Built
upright or horizontal, single or in pairs, and in a variety of styles to meet the requirements of almost any situation.



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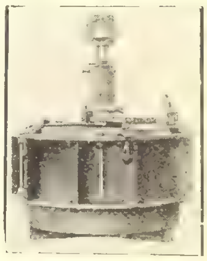

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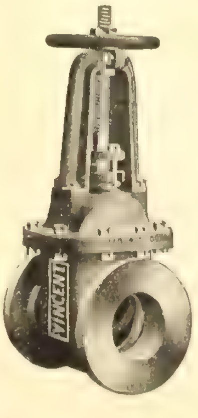

IT IS
ECONOMY
to use
VINCENT VALVES
because they are reliable
Vincent Valve Co.,
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SPARKS.

The ratepayers of Listowel, Ont., have voted in favor of assuming control of the electric light plant.

The British Columbia Electric Railway Company recently put their new dynamo into operation. It is capable of supplying 10,000 16 candle power lamps, and makes the total capacity of the Vancouver plant equal to 70,000 16 c.p. lamps.

The A. Forsyth Electric Company have commenced business at Berlin, Ont., as manufacturers and dealers in electrical supplies. They propose also to give special attention to repairs and will make a specialty of armature field and transformer windings.

Messrs. C. G. Cunningham and A. W. English have entered into partnership in the electrical construction and supply business under the name of the Cunningham Electric Company, with headquarters at Greenwood, B. C., and a branch at Edmonton, N. W. T.

The Petrolia Electric Light Company are negotiating with the town council of Petrolia, Ont., looking towards the remodelling of their plant. They propose to install an arc lighting system using 6.6 amperes series enclosed arc lamps. Mr. W. G. Fraser is manager of the company.

The new coal handling plant of the Canadian Pacific Railway Company at Fort William, Ont., is nearing completion and is one of the best of its kind on the continent. There are four steel frame towers, and the engines in each tower will be of the direct-acting type, the hoisting engines having 14x24 inch double cylinders and 24 inch double drums. The trolley engine is 9x12 inch and a single drum. The pick-up engine is 10x12 inch double cylinder, geared reversible type, having a drum and spool attachment, with brake and friction levers. The engine for driving the cable transfer is 10x12 inch double cylinder gear, having necessary gearing and drum for operating cable at a speed of 200 feet per minute. The engines for draining are 60 horse power of the automatic cut-off type. The boiler equipment consists of two 125 h. p. horizontal rotary tubulars.

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For a high speed engine the McEwen is an economical engine.

Its regulation is perfect and it gives a most satisfactory service for the special purposes for which it was designed.

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The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution.

Any engine failing to meet this guarantee becomes the property of the purchaser upon the payment of one dollar.

For street railway service, electric lighting, electric crane work, mine haulage or any service where loads fluctuate with rapidity the McEwen is the ideal high speed engine.

Its guarantee given herewith proves our contention that the McEwen has almost perfect regulation. We should be pleased to send you the catalogue of the McEwen showing its construction embodied in its making.

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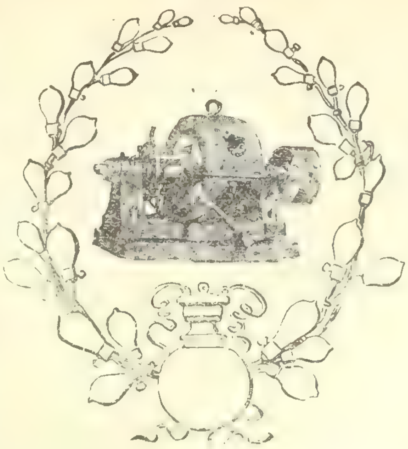

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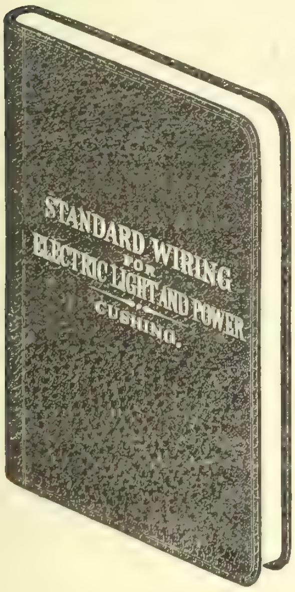

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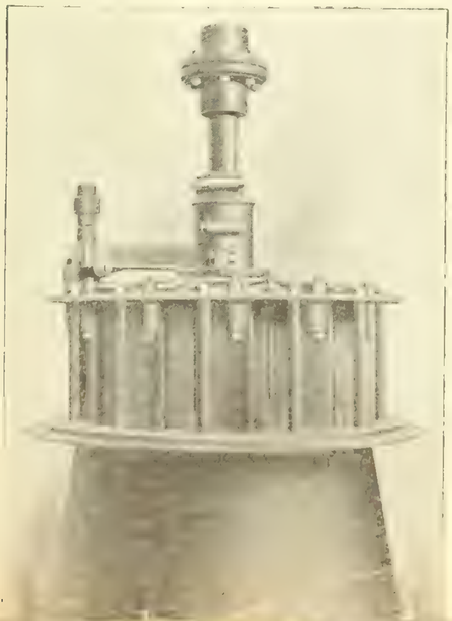

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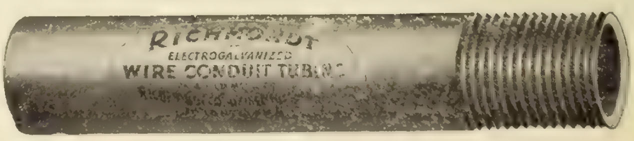

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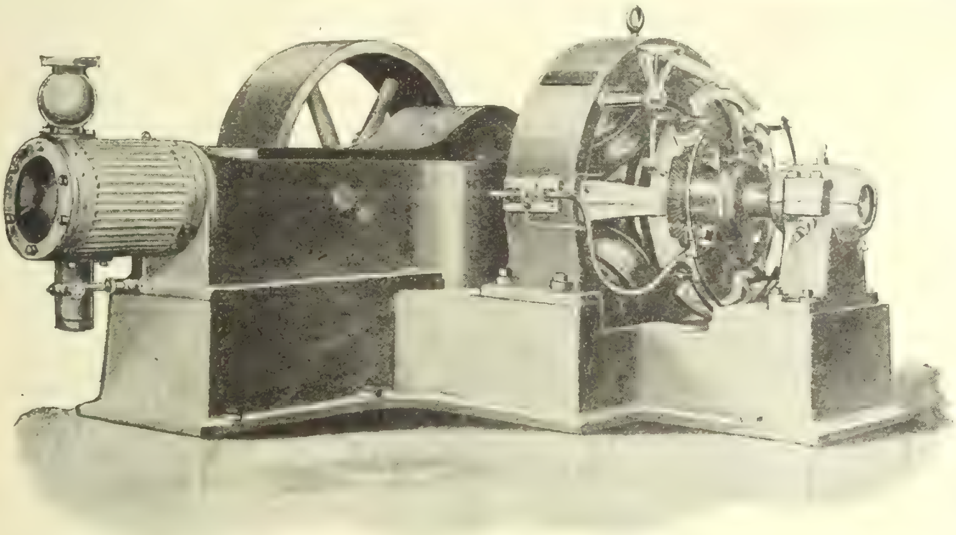

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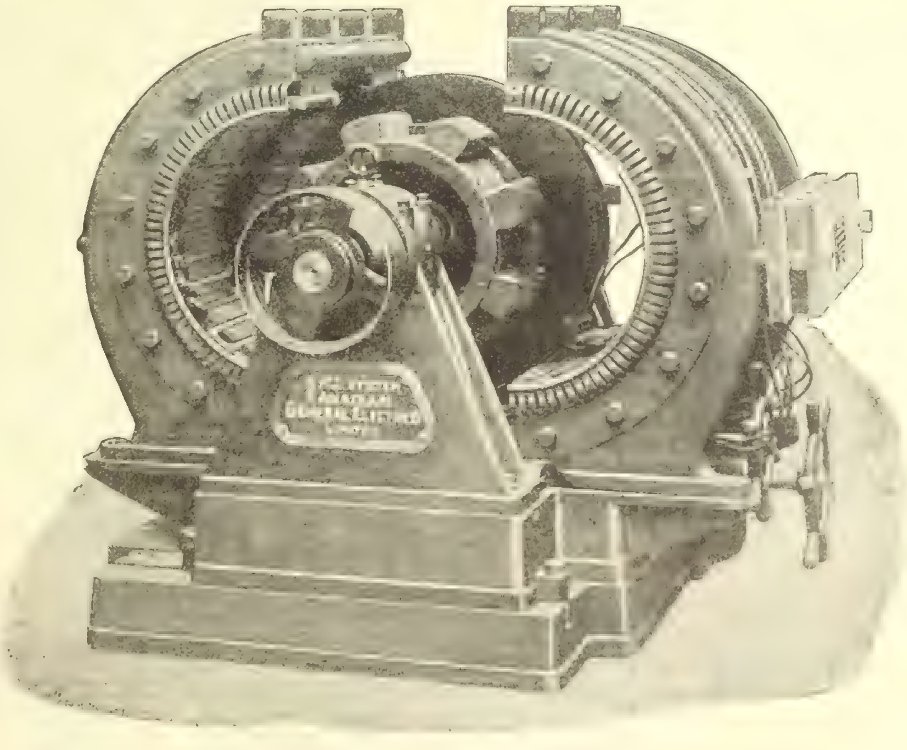

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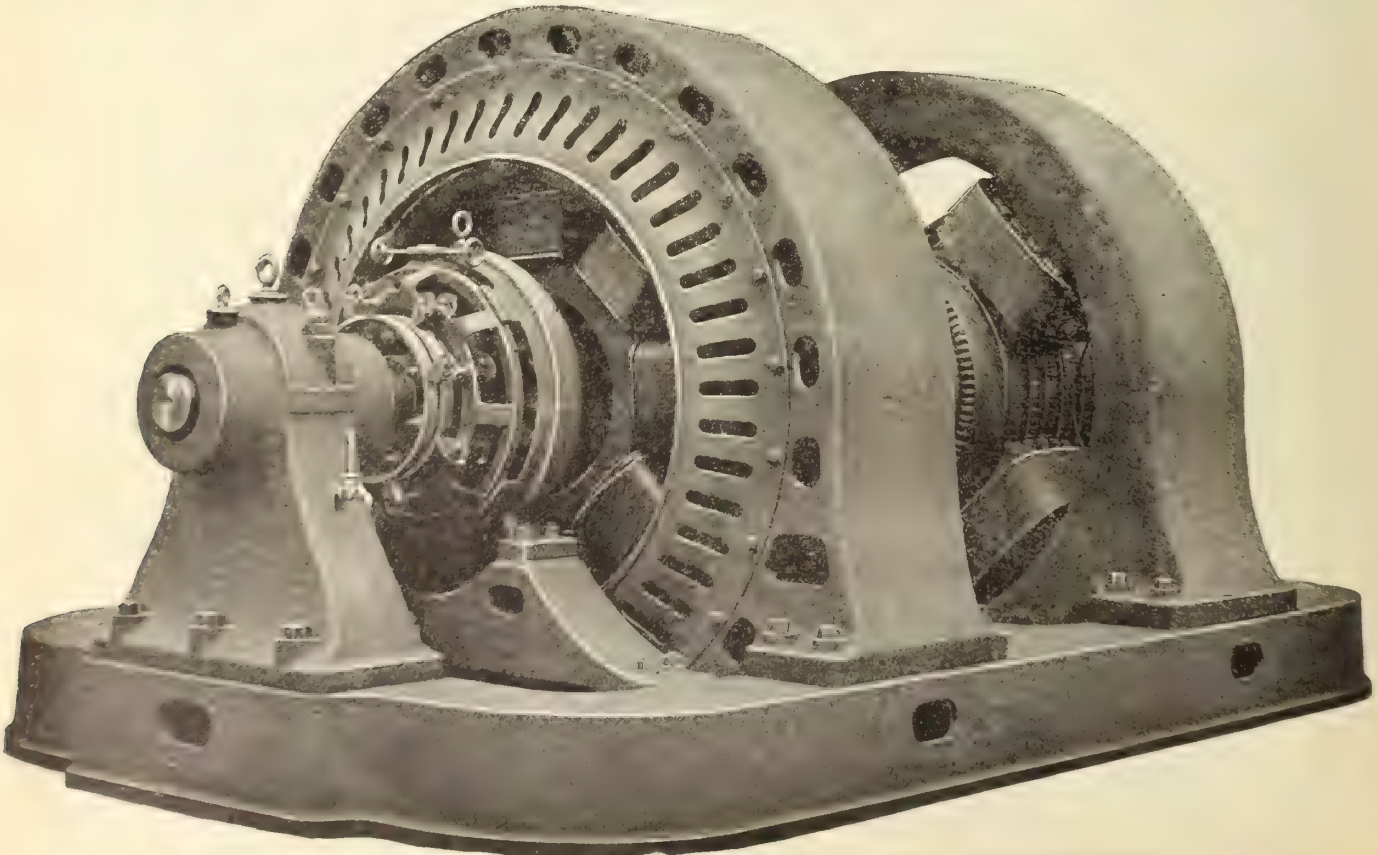

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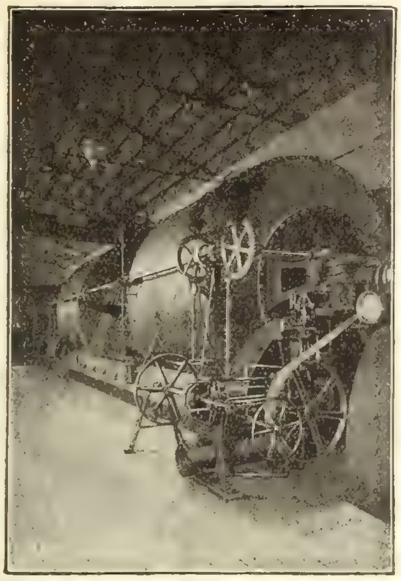

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Recently received the following unsolicited testimonial, which speaks for itself :

TORONTO, Aug. 6th, 190[illegible].

THE GOLDIE & MCCULLOCH CO., GALT, ONT.

DEAR SIRS :—In our recent fire which, as you know, was a total wreck, and of which we are sending you a photo by this mail, we had two Goldie & McCulloch safes in which we kept all our books. They have come through the fire in remarkable shape and we feel that our praise for your safes cannot be great enough. This fire was an extremely hot one, the locality in which these safes were being surrounded by hay and grain as well as large quantities of packages, barrels and boxes. We might say that everything was burned to a crisp, heavy iron being twisted and melted into frightful shape. We had almost given up all hope of being able to get the books and documents from the safes in such a manner as to make them of any use to us, which we can assure you would have been a very serious matter. We were agreeably surprised, however, on reaching them. While we found the safes somewhat warped and bent on the outside, yet all our books and documents came out in such a manner that we can get everything from them all right. This without a doubt was an extremely hot fire, and the way in which they came through it leaves no room for question as to the manner in which they are made and the stuff they are made of.

Again congratulating you on the safes you turn out and trusting we will have the pleasure of purchasing from you when we again rebuild, as we know of none better, we are,

Yours truly,
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PERSONAL.

Mr. T. E. Smith, superintendent of the Sherbrooke, Que., Street Railway, has tendered his resignation, and for the present the management is in the hands of Mr. Denio.

Mr. J. C. M. Buntzen, general manager of the British Columbia Electric Railway Company, accompanied by Mrs. Buntzen, is at present enjoying a vacation in the Old Country.

Mr. Luke Robinson, formerly superintendent of the Montreal Park & Island Railway, has been appointed assistant superintendent over the entire Montreal Street Railway and Montreal Park and Island Railway systems.

The Senate of the University of Toronto have appointed Mr. R. A. Ross, E. E., examiner in mechanical and electrical engineering. Mr. W. T. Jennings, C.E., has received a similar appointment in civil engineering, and Mr. G. R. Mickle, B.A., in mining engineering.

Mr. George F. Wardle, chief operator at the London office of the G. N. W. Telegraph Company, died at his home in London on January 30th, in his 49th year. Death was due to pneumonia. For the past thirty years he had acted either in the capacity of day or night chief operator and was one of the best operators in the company's service.

Mr. John Kerr, superintendent of the gas plant of the Kingston Light, Heat & Power Company, recently asked to be relieved of further service. This the company did not wish to do, but decided to relieve him of some of his duties if he would remain in the capacity of consulting superintendent. Mr. Kerr installed the plant fifty-three years ago, and has been connected with it ever since.

It is estimated that the Bell Telephone Companies of the United States will expend $25,000,000 during 1903 in extending their business, and at least 200,000 new subscribers will be added to the exchange.

The Bell Telephone Company intend to reconstruct the telephone exchange at Listowel, Ont., and install a metallic system. The local manager is Mr. J. H. Gunther.

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.		Extinguish.		No. of. Hours
		H.M.		H.M.	H.M.
1....	P.M.	6.20	P.M.	5.40	11.20
2....	"	6.20	"	5 40	11.20
3....	"	6.20	"	5.40	11.20
5....	"	10.00	"	5.40	7.40
6....	"	11.00	"	5.40	6.40
7....	"	0.00	"	5.40	5.40
8....	"	1.00	"	5.30	4.30
9....	"	2.00	"	5.30	3.30
10....	"	2.40	"	5.30	2.50
11....	"	3.30	"	5.30	2.00
12....	No Light.		No Light.		....
13....	"		"		....
14....	A.M.	6.30	A.M.	9.15	2.45
15....	"	6.30	"	10.15	3.45
16....	"	6.30	"	11.15	4.45
17 ...	"	6.40	"	0.15	5.35
18....	"	6 40	"	1.10	6.30
19....	"	6.40	"	2.00	7.20
20....	"	6.40	"	2.50	8.10
21....	"	6.40	"	3.30	8.50
22....	"	6.40	"	4.15	9.35
23....	"	6.40	"	4.50	10.10
24....	"	6.40	"	5.00	10.-0
25....	"	6.40	"	5.00	10.10
26....	"	6.50	"	5.00	10.10
27....	"	6.50	"	5.00	10.10
28....	"	6.50	"	5.00	10.10
29....	"	6.50	"	5.00	10.10
30....	"	6.50	"	5.00	10.10
31....	"	6.50	"	5.00	10.10
			Total...........		215.45

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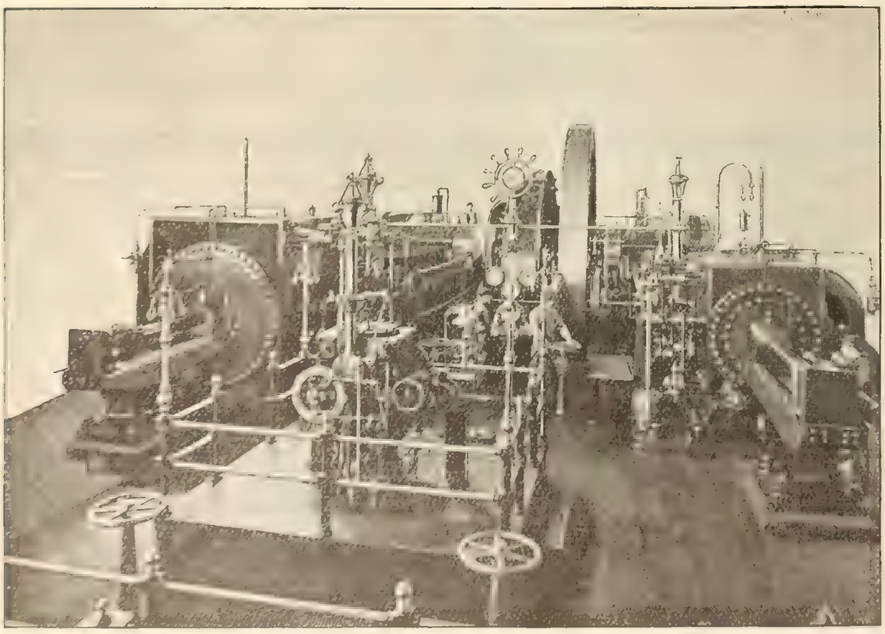

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Montreal Street Railway Co. - 11,500 H.P.
Dominion Iron & Steel Co. - 2,400 H.P.
Cape Breton Electric Tramway Co. 1,200 H.P.

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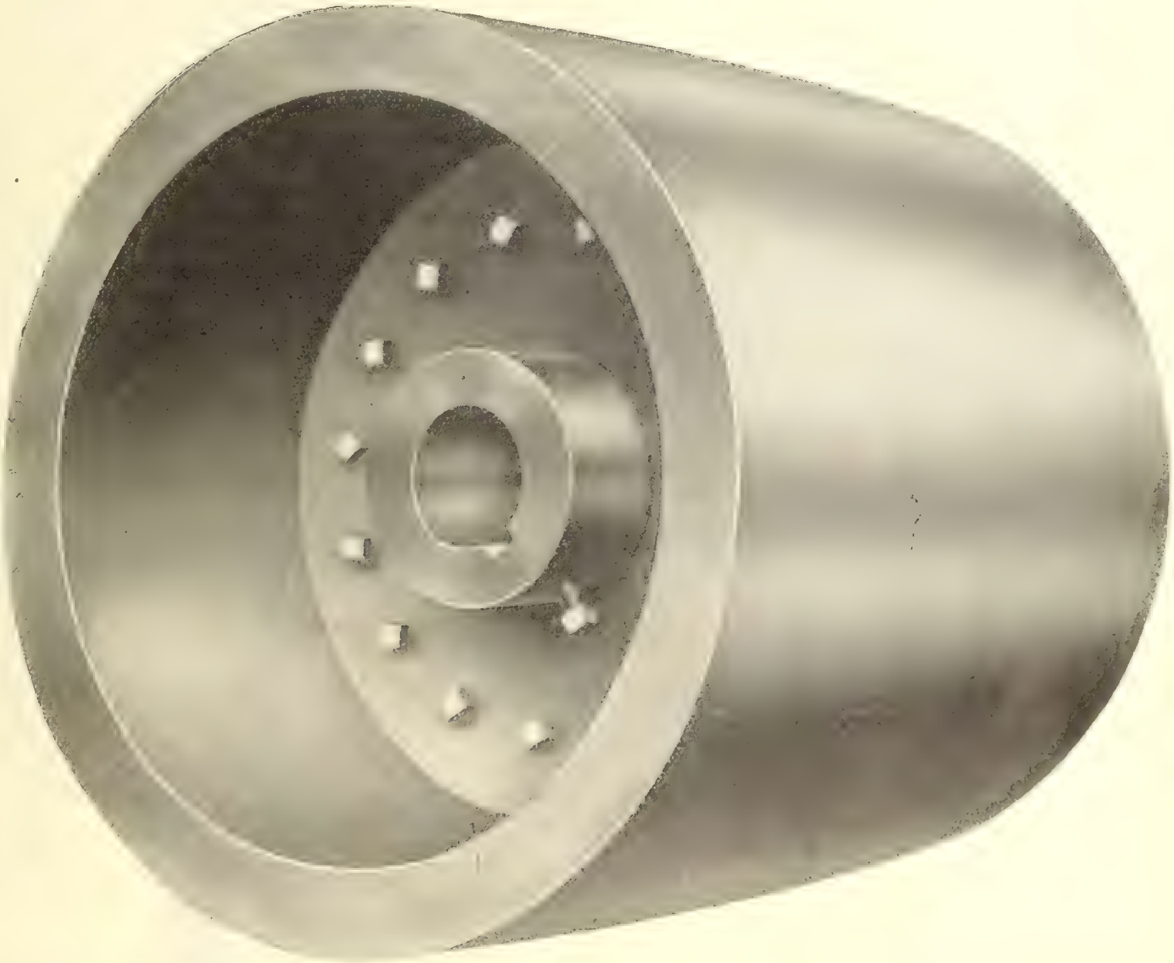

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SPARKS.

B Bell & Company, Limited, of St. George, Ont., have installed a 200 light dynamo in their factory.

The annual meeting of the Richmond County Electric Company will be held at Richmond, Que., on February 9th.

Mr. C. K. Milburns is endeavoring to form a company to establish a copper refining plant at Shawinigan Falls, Que.

In the new C. P. R. hotel at Glacier, in the Selkirk Mountains, there will be installed an electric light plant. The contractor for the building is Joshua Holland, of Victoria, B. C.

The British Columbia Electric Railway Company propose to build several large inter-urban service cars. Extensions will also be made to the plant, including a car house 40x120 feet and a paint shop 40x60 feet.

The Guelph Street Railway Company, of Guelph Ont., will apply for incorporation and for power to change the name to the Guelph Radial Railway Company, also to build extensions from Guelph to Elora, Fergus, Galt and Preston.

Last year an electric light plant was installed by the corporation of Kamloops, B. C. There are now in use 2,351 commercial lights and 125 street lights. Of the latter sixty are 100 c. p., forty-four 16 c. p., and twenty-one 32 c. p.

The Mayor, Ald. Meek, Ald. Chant and Ald. Sanders have been appointed a committee to act with the City Engineer in the management of the electric railway at St. Thomas, Ont. Steps will be taken immediately to improve the road.

The Montreal Light, Heat & Power Company will again light the harbor of Montreal this year, at the price of $54.75 per arc light for the season of navigation. This company will also furnish the electric power for the new grain elevator.

The Kingston Light, Heat & Power Company have been notified that the Court of Appeal has refused to award the company $80,000, the alleged value of the franchise. The company will probably carry the appeal to the Judiciary Committee of the Privy Council.

France has a government telephone service. A recent statement is to the effect that the service in Paris has always been bad. So serious has this become that a league of telephone subscribers has recently been formed in the city for the purpose of forcing the Minister of Posts and Telegraphs to improve matters.

The E. S. Harrison Company, of Winnipeg, in connection with the Barnet & Record Company, of Minneapolis, have obtained the contract for lighting the C. P. R. elevator "D" at Fort William, Ont. The machinery in the new Canadian Northern elevator at Port Arthur.

Mr. E. F. Hutchings and G. H. Leech, on behalf of the Winnipeg & St. Andrew's Rapids Railway Company, have applied to the City Council of Winnipeg for running powers over the Louise bridge. The company expect to build ten miles of electric railway next summer.

The long-pending suit brought by P. H. Patriarche against the town of Orillia, Ont., and Peter Ryan to recover the sum of $211,462,50 for the construction of the Ragged Rapids power plant, is now being heard at Orillia. William Laidlaw, K. C., appears for Mr. Patriarche and E. F. B. Johnson, of Toronto, and R. D. Gunn, of Orillia, for the town, while James Haverson is acting for Mr. Ryan, who is included in the action by reason of having advanced money for the construction and now has claims on the possible proceeds of the suit. The facts leading up to the suit have previously been given to our readers.

Mr. W. Pierson Judge, of Oswego, N. Y., representing the Hamilton and Lake Erie Power Company, has submitted a proposition for the supply of electrical energy to the city of Toronto. The company is incorporated under a Dominion character, granted in 1895. It is proposed to tap the Welland river, which runs from the Niagara river, and to build a canal from the Welland to the Jordan rivers, by which means it is estimated that 100,000 h. p. can be developed. The company is prepared to enter into an agreement to deliver to the city of Toronto 10,000 horse power at $25 per h. p.; 22,000 horse power at $22.50 per h.p., or 30,000 horse power at $20.00 per h. p. The company further agrees to put up a deposit of $75,000 as a guarantee for the proper fulfilment of the contract.

Sometimes an overload is inevitable. A good transformer will stand up to an overload better than a poor one will.

The following happened in Ann Arbor, Mich. :

"The Washtenaw Light & Power Co. have about 83 Pittsburgh transformers in operation. Mr. R. W. Hemphill, jr., manager of the above company, states that they made tests on seven different makes of transformers before putting in the Pittsburgh, and he considers the Pittsburgh the best transformer on the market.

They have two 200 light Pittsburgh transformers connected up in the Opera House block. This makes a heavy load on Saturday night when the Opera House is lighted in addition to the stores. The fuse blew on one of the 200 light transformers Saturday night and the other one carried the double load until the following Wednesday with no burn out. Mr. Hemphill states that the transformer carried 107% overload."

The R. E. T. Pringle Company, Limited.

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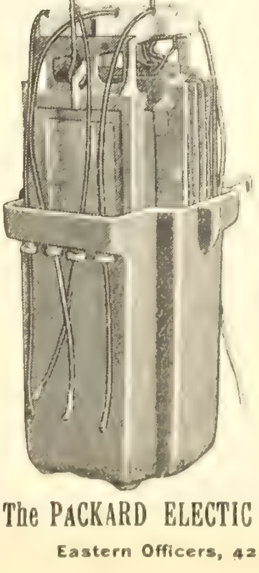


In Transformer operation, regulation, efficiency and ultimate economy are factors of equal weight.

In many makes of Transformers regulation is sacrificed to efficiency.

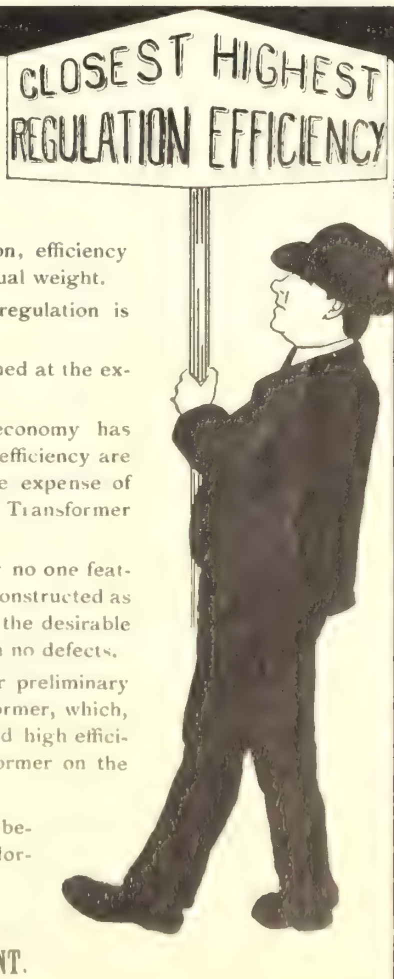
In other makes regulation is attained at the expense of efficiency

In still other makes the ultimate economy has little consideration and regulation and efficiency are both attained to some degree at the expense of some vital feature which makes the Transformer most expensive in the end.

In Type "R" Packard Transformer no one feature is subordinated to any other, and, constructed as it is along new lines, it incorporates all the desirable features of Transformer operation with no defects.

We shall be pleased to send you our preliminary bulletin descriptive of this new Transformer, which, due to its long life, close regulation and high efficiency, is the most economical Transformer on the market to-day.

It rightly deserves its distinction as being in the lead in the march of Transformer progression.



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Lead Covered Cables for all purposes
Submarine Cables

WATSON JACK & COMPANY
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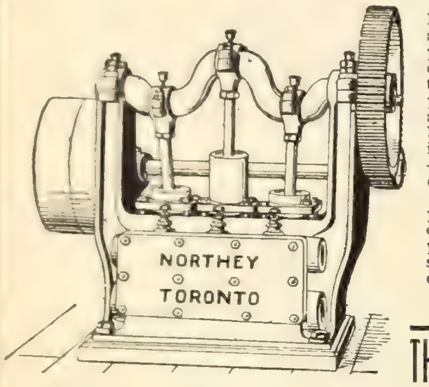

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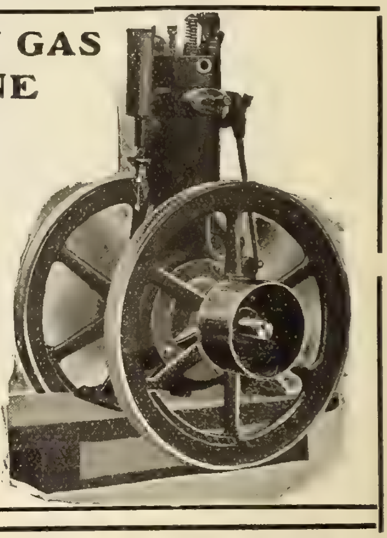

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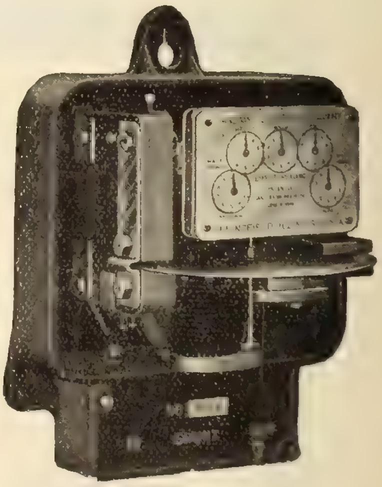
The New Meter is of the sealed type.
Is correct on all loads from two per cent. of its capacity to fifty per cent. overload.
Internal losses are practically nothing.
Accuracy maintained.
Simplicity in design.
Firmly constructed.
Dust, insect, moisture and water proof.
Extremely light weight (10 lbs.)
Pleasing in appearance.
Reads directly in watt hours.
Easily installed.
No complicated parts.
No friction.



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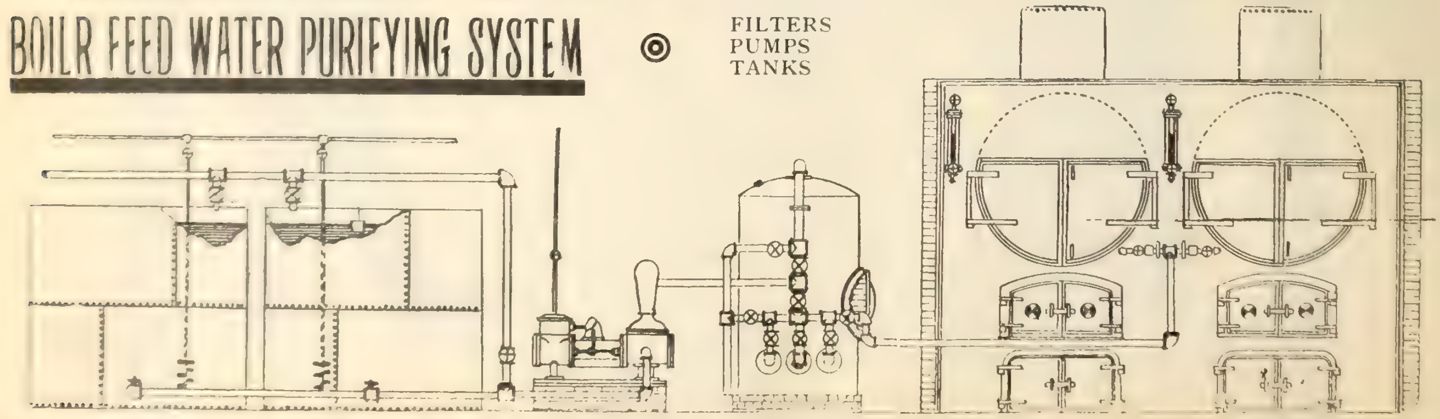
PUMPS
TANKS



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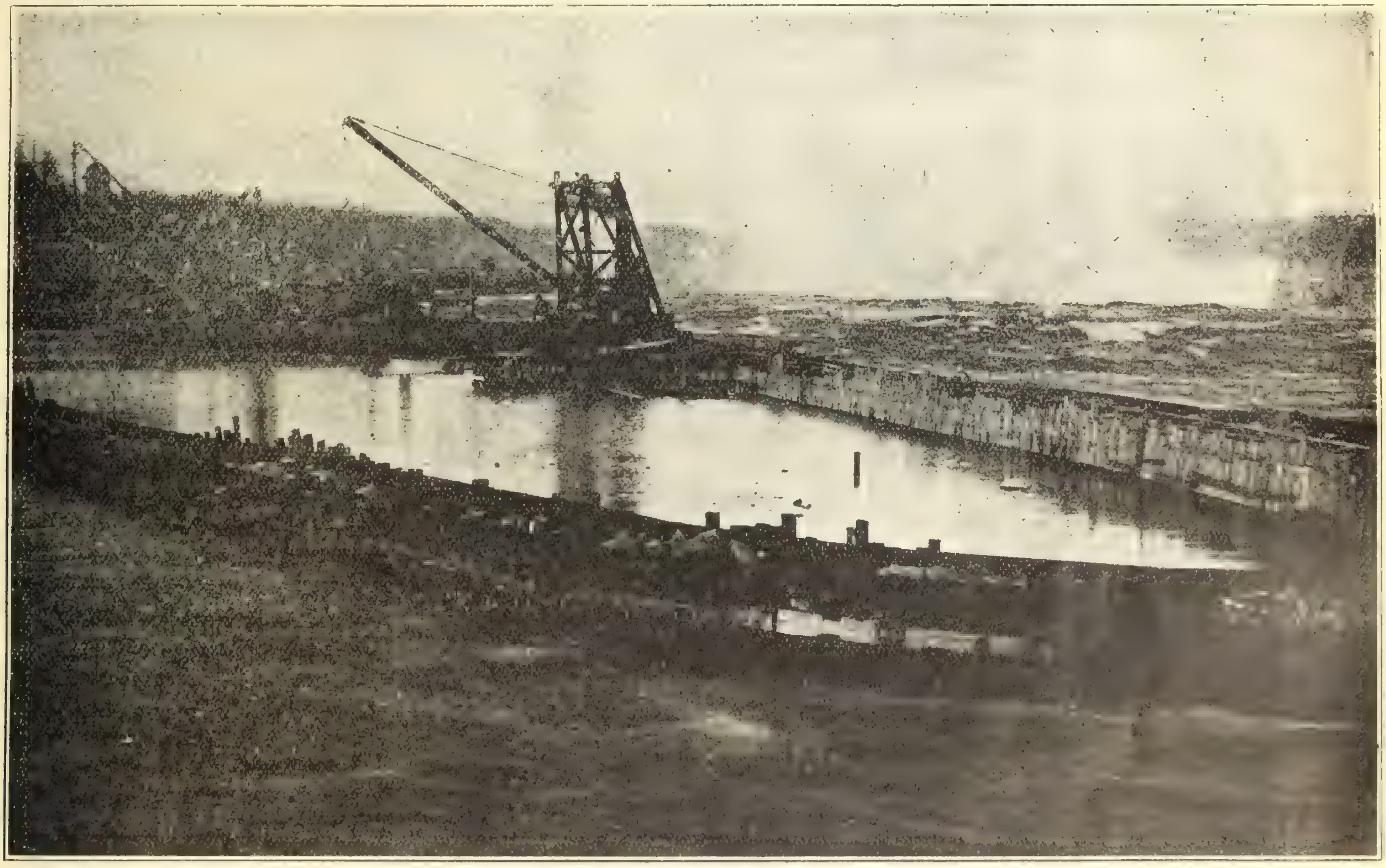
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIII. FEBRUARY, 1903 No. 2.

THE CANADIAN NIAGARA POWER DEVELOPMENT.

In no part of the Dominion of Canada are the power resources of that country undergoing more active development than on the Canadian side of the Niagara Falls. The site of this development is in Queen Victoria Park, a plot of ground lying close by the Horseshoe Falls and acquired for pleasure purposes, in order that mankind might view the stupendous spectacle of the mighty cataract untaxed. The spirit of industry is, however, creeping into the pleasure plot confines, and already two companies have acquired franchise rights allowing them to develop large blocks of power, while a third company is now having its application considered by the government.



BUILDING A NEW INTAKE TO THE WATERWORKS, NEAR THE BRINK OF THE HORSESHOE FALLS, CANADIAN NIAGARA POWER COMPANY.

The companies which now have franchises are the Canadian Niagara Power Company and the Ontario Power Company, while the Toronto Niagara Power Company's application is pending. The Canadian Niagara Power Company is practically the same as the Niagara Falls Power Company, which company owns the remarkable development at Niagara Falls, N. Y.

At one time this company controlled the exclusive privilege of developing power in Victoria Park, but saw fit to relinquish the exclusive features of its franchise, since which time the other companies have sought for rights there. The locality of the development is ideal, and it is possible to develop a very large amount of power, but it should be stated that all the power developed must be transmitted beyond the park limits for commercial application. In other words, the industrial sites will be outside the park, while a portion of the developed force will be transmitted to the New York side of the river.

THE CANADIAN NIAGARA POWER COMPANY.

Inasmuch as the method adopted by the Canadian

Outer End of the Big Wing Dam, Ontario Power Company.

Niagara Power Company for its development practically the same as that of the Niagara Falls Power Company, it will have the advantage of the latter company's valuable experience, both in the construction work and in perfecting the marvellous installation that is prospective. Thus the Canadian Niagara Power Company is sinking a wheel pit and building a tunnel tailrace to carry the water from the wheel pit to the lower river. The site of the wheel pit is less than 2,500 feet back from the crest of the Horseshoe or Canadian Fall. The plan calls for a wheel pit 480 feet long, but at present the section being built is 266 feet long, 21 feet wide and 170 feet deep. The contractors are Messrs. Dawson & Riley, of St. Catharines, Ontario, and it is intimated that the same firm of contractors is about to receive an additional contract for extending the pit to its full contemplated size. The wheel pit is being sunk through solid rock, the conditions of the excavation being very similar to those found in the construction of the two big pits on the New York side by the Niagara Falls Power Company. The pit has reached the depth of 130 feet. The sides are channeled, making it probably the biggest job of channeling ever done in the Dominion.

The progress in sinking the wheel pit is about twelve feet a month. Dawson & Riley have also the contract for building the forebay and canal in connection with the pit work. This forebay will be the full length of the pit, and will flare out in front of it to a point where it will be crossed by the tracks of the Niagara Falls Park and River Railway. At this point it will narrow down to a canal-like section, later flaring out toward the river. The electric line referred to will cross the forebay on a stone arch bridge that is expected to be the finest structure of the kind in the Niagara locality. It will have a length of 250 feet, and will be erected in five arches of graceful size and style. It will have a width of sixty feet. The forebay will carry an average depth of eighteen feet of water. The bridge is being built by Mumford & Lowery, of Niagara Falls, Ont. From

New Wheel Pit of the Canadian Niagara Power Company, to be Lined with Brick.

the north end of the forebay, near the wheel pit, a canal sixteen feet wide and 500 feet long will be built to serve as an icerun, the flow to be regulated by gates.

The tunnel that will carry off the discharge from the turbines will be 2,200 feet long, 25 feet high and 18 feet wide at the spring line. It will be observed that it is four feet higher than the big tunnel on the New York side, but its length is less than a third of the original Niagara power tunnel. Anthony C. Douglas has the contract for the construction of the tunnel, and has driven it through the rock from the pit to the face of the cliff. The portal is located very close to the base of the Horseshoe. Contractor Douglas is now removing the bottom bench of the tunnel. It was originally intended to line the tunnel with brick, similar to the lining of the New York tunnel, but a scarcity of brick has forced the adoption of concrete for a portion of the lining, and for this reason concrete is being used from the spring line down. This application of concrete will do away with the use of at least 3,000,000 brick. However, brick will be used in lining the arch, and 250,000 will be so placed, while the concrete lining will be faced with vitrified brick. The brick is obtained from Beamsville, Ontario. The rock excavated from the bottom bench is used in making the concrete. Twenty thousand barrels of Lehigh cement will be used in making the concrete. To indicate the further great consumption of material, it may be pointed out that over 2,000,000 feet of timber were used in timbering the tunnel, that sixty carloads of granite and 200 carloads of Queenston, Ontario, limestone will be used in the masonry work about the portal of the tunnel. The portal being located so close to the falling waters of the Horseshoe it will ever be under the influence of the spray of summer and the ice of winter, features that demand unusual construction work.

Contractor Douglas' plant consists of two compound, duplex, 125-horse-power Ingersoll air compressors; one 400-horse-power motor to operate them, the current being transmitted from the New York side; twelve drills; two Lidgerwood hoists, with double drum; one Otis elevator lift at the shaft, ten by sixteen feet, located midway between the portal and the pit; one rock-crusher, and other incidental equipment.

Dawson & Riley's plant consists of 750-horse-power boiler capacity; two compound Rand air compressors of 250 horse-power each; eight Sullivan channeling machines; two gadders and eight drills of Ingersoll make, and two ten-ton Brown locomotive hoists.

In the two plants of the Niagara Falls Power Company the development is made in units of 5,000 horse-power. On the Canadian side, in the plant of the Canadian Niagara Power Company, the unit of development will be 10,000 horse-power. When the development on the New York side at Niagara was projected, men in the interested professions could hardly wait the operation of machines of such wonderful output capacity, and now a similar feeling exists in regard to the installation of the Canadian Niagara Power Company. In the wheel pit there will be ten turbines, each of 10,000-horse-power output capacity, making the total proposed development by the pit 100,000 horse-power. Contracts for three of these wonderful turbines have been placed with Messrs. Escher, Wyss & Company, of Zurich, Switzerland. In design they will be similar to those installed by the Niagara Falls Power Company in wheel pit No. 2, the wheels in which are of the Francis, or inward discharge type.

The generators to be installed in the Canadian power station will be wound for 12,000 volts, three-phase, twenty-five-cycle-current, and will make 250 revolutions per minute. This will give a uniformity with the plant on the New York side, permitting of parallel operation. The generators will be of the internal revolving field, vertical-shaft type, and the revolving parts of the machines will weigh 141,000 pounds. The General Electric Company will build the generators. They will be about nineteen feet in diameter. In adopting a unit of 10,000 horse-power for the Canadian-Niagara development, the Canadian Niagara Power Company will effect lower cost of generator per horse-power, and lower cost of turbine per horse-power, while in using this unit there is a saving in cost of construction for a given output in the matter of the wheel pit, station, etc. Toronto is a prospective market for a portion of the current generated at Canadian-Niagara, and for transmitting such distances the voltage will be increased by step-up transformers to 22,000, 40,000 or 60,000 volts.

THE ONTARIO POWER COMPANY.

In the development of its prospective 100,000 horse-power the Ontario Power Company will erect a plant similar to that of the Niagara Falls Hydraulic Power and Manufacturing Company on the opposite side of the river. However, instead of having a surface canal to conduct water from the upper river to its power station it will lay one or more large pipes through Victoria Park, close along the base of the bluff that skirts the park in the rear. The company's forebay will be well up the river above Dufferin Islands, and there will be a gate house at the foot of the forebay. The pipe line referred to will convey the water supply to a point below the Table Rock house, at which point the water will pass into penstocks that will carry it down the bank to the power station, which will be located at the water's edge in the gorge. This power station will be but a few hundred feet distant from the Horseshoe, and will be the nearest building ever erected in the gorge to that great eye feast of falling water. The site is now being excavated, and a large portion of the debris has been cleared by the use of giant powder and dynamite. In this work the rock was thrown out in the river in order that the expense of handling it might be thereby lessened. So far this company has not announced the style or type of the generators or wheels to be adopted in its development.

In preparation for its forebay construction the Ontario Power Company has thrown a long wing dam out in the river above Dufferin Islands. This dam is nearly 800 feet long, and a splendid piece of work. It has had the effect of diverting all the water that heretofore flowed about the Dufferin Islands, and that section of the river bed is now quite dry and will remain so until the construction work in that locality has been completed.

The resident engineer of the Canadian-Niagara Power Company is Mr. Cecil B. Smith, while Mr. Wm. A. Brackenridge, of the Niagara Falls Power Company, is consulting engineer. Mr. Brackenridge has had extended experience in the Niagara power development, and Mr. Smith is an engineer of well-known ability.

THE TORONTO-NIAGARA POWER COMPANY.

The Toronto-Niagara Power Company has only recently made application to the commissioners of Queen Victoria Park for the right to develop power to the extent of 100,000 horse-power in the park. It is understood its plan of development contemplates the construction of a wheel pit and tunnel.

During the progress of the work of the Canadian-Niagara Power Company the excavated material from the tunnel shaft and wheel pit has been used in filling in various places in order that the locality might be beautified. At one spot an embankment has been built out to the very edge of the Horseshoe Fall, and when this is riprapped and carefully graded it is expected to be a great improvement, while also forming a delightful scenic point of view.—Orrin E. Dunlap, in the Electrical Review.

ELECTRICAL DEVELOPMENT IN THE WEST.

Electric light and power promises in the near future to become much more universally employed throughout Western Canada. Several municipalities in Manitoba are now installing electric lighting plants, and the equipment of new office buildings, elevators and industrial establishments frequently includes an electric plant for lighting and power purposes. Closely associated with this development is Mr. E. S. Harrison, electrical engineer, of Winnipeg, who is interested in several electrical undertakings in the west. One of these is the construction, by the Suburban Rapid Transit Company, of an electric railway between Winnipeg and Headingly, a distance of twelve miles. The grading and bridging for one-half the distance was completed last year, and it is intended to lay the rails and ties this spring and to have the road in operation by the summer.

Mr. E. S. Harrison.

Mr. Harrison is installing a complete plant at Carman, Man., for the Carman Electric Light & Power Company, of which he is a director. This plant will consist of three 65 horse-power boilers manufactured by the Vulcan Iron Company, of Winnipeg, and two 65 horse-power and one 35 horse-power Robb-Armstrong engines direct connected to two 40 k.w. and one 20 k.w. 250 volt, direct current, Western Electric generators. One unit and one boiler has already been set up, and the balance of the plant will be installed early in the summer. Over 700 lights have been wired and the balance will be connected up as fast as the wiremen can execute the work. A plant similar to the above will be installed this spring at Minnedosa.

At Banff Mr. Harrison is installing in the C. P. R. hotel two 50 h. p. Ideal engines direct connected to two 30 k.w., 125 volt, Western Electric generators.

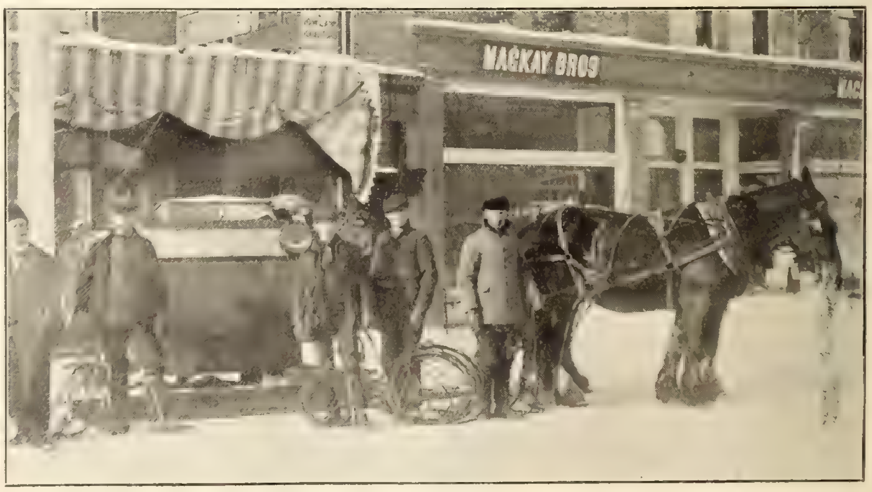
Among other installations which have been placed in the hands of Mr. Harrison may be mentioned the following: Forty k.w. 125 volt generator, direct connected to 65 horse-power Ideal engine, in the Strathcona Block, Winnipeg; one 15, one 10, and one 5 horse-power, 500 volt motors, with Cutler-Hammer speed regulator, in the Codville Spice Mills, Winnipeg; 9 k.w. 110 volt generator, in the Leland Hotel, Winnipeg; 32 Petite alternating enclosed arc lamps in departmental store of Robinson & Company, Winnipeg; wiring of new elevator and the Kaministiquia Hotel at Fort William, Ont., for the Canadian Pacific Railway, and wiring of two elevators at Port Arthur, Ont., for the Canadian Northern Railway.

THAWING OF WATER PIPES BY ELECTRICITY.

The thawing of frozen water pipes by means of electricity is a possible source of revenue for central stations which has as yet received little attention. An exception is the Tagona Water & Light Company, of Sault Ste Marie, Ont., which has for some years derived considerable revenue from this work. The idea originated with Mr. William Gorby, electrician of the company, who read an article by a college professor stating that water pipes could be thawed out very quickly by causing an electric current to traverse that part which is frozen. He immediately proceeded to make a test, with mostsatisfactory results.

The accompanying illustration of the apparatus used shows a 250 k.w. transformer mounted on a sleigh, this transformer being used because at the time a smaller one was not available. Generally all the pipes in the town can be thawed out by a 500-light transformer, but two of these are ample to thaw out any pipes likely to get frozen. The primary wires (2,200 volts) are bared and the current led through a water rheostat to the transformer. An ammeter shown in the engraving indicates the load on the transformer primary. The secondary is connected to the frozen pipe at two places and the current switched on. In the ordinary house service pipes the water begins to flow very quickly, frequently within a minute.

The charge for thawing pipes depends altogether on each individual case, varying usually from $3 to $5 and occasionally reaching $10, depending on the size of the pipe and the length of time necessary to thaw it out. The largest pipe yet thawed out was a four-inch cast iron pipe, which was frozen more or less for 200 feet. It took at least half an hour to get the water running. It is said that this method of thawing water pipes has resulted in a large saving to the citizens of Sault Ste Marie.



Apparatus Usdd for Thawing Water Pipes at Sault Ste. Marie, Ont.

QUESTIONS AND ANSWERS

"Enquirer": What is the difference between the commercial and the electrical efficiency of a dynamo or motor?

Ans.—The latter takes into account only the losses which are purely electrical, such as the resistance of the conductors, and the core losses. Commercial efficiency includes not only these, but in addition the various mechanical losses which exist in every machine, for instance the friction of the brushes, windage, and the friction of the bearings.

"Student": What is meant by power factor?

Ans.—In alternating current work the current and voltage are very seldom in phase with each other, if they are not their product does not represent the true power, which is less by an amount depending on the extent which the current leads the voltage or lags behind it. The factor by which their product has to be multiplied to get the true power is called the power factor. Thus, if the power factor of a circuit carrying 10 amps. at 1000 volts is 85%, the true power is 10 x 1000 x .85 or 8.5 k.w.

"Subscriber" writes: How can a circuit of 17 street lights 32 c.p. each, be arranged from power house on a circuit of 1040-110 volts alternating current?

Ans.—17 lamps on a 1040 volt circuit means $1040 \div 17 = 61$ volts per lamp. Assuming that they are of an efficiency of 3½ watts per candle, each lamp will take $32 \times 3\frac{1}{2} = 112$ watts, $112 \div 61 = 1.83$, which is the amperage consumed by a 112 watt 61 volt lamp. Therefore, you can operate 17 32 c. p. lamps in series from a 1040 volt circuit if you make them of 1.8 amps. capacity. You will note that this is a special lamp, which will take longer to obtain than standard sizes. Further, you will likely find your voltage is 5 or 10 per cent. higher than 1040, in which case one or two extra lamps, installed in the power house, and equipped with short circuiting switches, will enable you to compensate for this increased pressure and thus save burnt out or strained lamps.

"Engineer": A compound wound dynamo when thrown into parallel with two other shunt wound machines does not take any of the load. What is likely to be the difficulty?

Ans.—It may be due to one of two causes, either your series field is reversed, or else the driving power is not sufficient to keep up the speed, in which event it will drop and thus lower the voltage and consequently the load the machine takes. We would suggest that you connect the series coils the other way; if this does not remedy the trouble examine all your belts, pulleys, etc., perhaps there is something loose or slipping.

"Reader": I note your remarks in regard to my enquiry and believe you have taken a wrong view of the case. Changing 16 old code to 18 new code does not increase the size of conductor; on the contrary it decreases it and this is the safety paradox referred to. The insulation of new code is somewhat thicker than old code, but surely this alone does not warrant retroactive action. The question of inspection in Montreal is pecular, the Underwriters will not appoint one, claiming it is the function of the city, whereas if the latter did appoint one, municipal politics would probably figure in the appointment to such an extent that the Underwriters would not recognize the appointee. Hence the rules "as read" are enforced by general inspectors of the Underwriters, and of individual insurance companies.

Ans.—You are quite correct in saying that changing from No. 16 to No. 18 is decreasing the size of the conductor, but we referred to the first case of "ordering out," of which "Reader" spoke, namely, the substitution of 16 for 18. As we said before, we have yet to hear of a case of wholesale changing in the equipment of a building in order to make it correspond exactly with a change in the Underwriters rules. New work is supposed to be put in according to those in force at the time the contract was let, old work being passed as it is unless it is notoriously deficient in any of the more essential points.

"Winnipeg": What are the main points of difference between surface and jet condensers? Which type is most suitable for use with steam turbines?

Ans.—In the former the steam is condensed by coming in contact with surfaces, which are kept cool by water on the other side of them, the steam and the water being kept separate all the time. On the other hand, in the jet type, as its name indicates, the steam is condensed by means of a jet of water which is directed into it, the two mingling at the point of entry into the condenser and being discharged therefrom as one. This latter type is, on the score of economy, much to be preferred for use with any type of steam motor, whether reciprocating or rotating, as it uses much less water than the other type. This advantage is sometimes outweighed by the fact that the steam coming from an engine of the former type contains a large amount of oil, and therefore if a jet condenser be used the discharge has to be filtered before being sent to the boilers. This is not the case when turbines are used, as the steam from them contains no oil, nor yet when the ordinary steam engine is controlled by a surface condenser where, as stated above, the condensing and condensed waters are kept separate.

"J. L.": Can a standard compound wound generator be used as a booster? If so how will it compare with a proper machine built for that purpose?

Ans.—As a general rule any compound dynamo can be operated as a booster, but depending on the particular machine in question you may or may not get satisfactory commutation, especially if you desire to carry an amperage which approaches the normal load of the armature. Further than this, depending on the amount of series winding on the fields, you may not be able to get sufficient boosting effect. Compared with a proper booster the main points of difference will be, as above, the possible poor commutation and lack of sufficient voltage, together with the fact that your voltage will not be exactly proportional to the current passing, which is considered a most important point. You will also note that owing to the fact that your field magnets are not nearly saturated even at the highest loads, your machine is unneccessarily large and heavy, which in turn means that your efficiency is poor.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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A New Converter.

The announcement is made that Mr. Peter Cooper Hewitt, whose name is familiar to electrical men through the exploitation of the mercury vapor lamp which he has perfected, has been successful in producing a chemical process for the conversion of alternating into direct current. Briefly the system consists in passing the alternating current through a vessel containing certain gases or vapors which allow the passage of the current in one direction, but which oppose it when in the other. It will at once be seen that the apparatus has an enormous field before it if it can be made commercial, seeing that it requires no more attendance than the ordinary oil-cooled transformer, and weighs only some two per cent. of the standard rotary. The information which up to the present has been made public is extremely vague, though some wonderful predictions have already been made on it, but it does not yet appear that the owners of patents on rotary converters are losing any sleep over the possibilities of the latest arrival.

The Salesman of the Future.

The time is now plainly in sight, if it be not here already, when the salesman for electrical companies can no longer secure large and lucrative business owing purely to his personal relations with the customer and his ability to make himself generally hail fellow well met. In the early days of any rising industry, and electricity has been no exception to the general rule, the personality and individuality of the salesman, rather than the intrinsic value of the apparatus he had to offer, were the main and dominating features deciding the closing of many large contracts, the prices, in the light of the figures obtaining to-day, being fabulous, as were also the estimated capabilities of the apparatus concerned. To-day the practice is much changed, the buyer has learnt to a great extent to discriminate between reasonable statements and guarantees and claims which commercially are entirely incapable of fulfilment. This increase of knowledge on the part of the purchaser must be catered to by a corps of salesmen who possess, to a corresponding degree, technical information concerning their own and their competitors' machinery. That this demand is being met is evidenced by the ever increasing number of men on the selling staffs of the various manufacturers who, in addition to their commercial education, have had considerable engineering training, both theoretical and practical.

A Novel Transmission Line.

The plans for a 105 mile transmission plant, to be installed in Mexico, which are now being prepared, cover some rather novel ideas in line construction. Instead of wood poles, spaced at the ordinary distances of 90 to 150 feet apart, steel towers are to be used, placed on 440 feet centres, which is a large increase over the distances commonly used to-day. As the line potential will be 60,000 volts, there is to be but one three wire transmission line to each set of towers, repairs to a dead line being out of the question if there is another line working at that potential on the same pole. This decrease in the number of poles per mile, of course, means a corresponding reduction in the insulators, by which means it is hoped to decrease the amount of trouble, as each of these latter forms a weak spot in any transmission line. In view of the increased length of the spans it is proposed to use a stranded cable instead of the usual solid line wire. The conductivity will be equal to a No. 1 B & S gauge. Steel pins and steel cross arms will be used, otherwise any defect in an insulator would mean the destruction of the pin and possibly that of the arm as well, with its attendant damage to the pole, whereas if they are metallic any breakdown simply becomes a short circuit without damaging anything but the insulator and possibly the wire itself. From the above it will be seen that the line, if installed according to the methods now proposed, will be radically different in many points from what is to-day considered standard practice, and one whose cost of building and results of operation will be watched with interest.

Standards for Direct Connected Units.

Notwithstanding the fact that the best methods of attaching to each other the engines and generators of direct connected sets, and also the question as to the most advantageous sizes and arrangements of the various parts of either machine which affect the other, have been discussed time and again by the more prominent steam and electric manufacturers and by the engineering societies and technical press concerned, there still remain many features which, undecided and indefinite, increase the cost of production of the unit and leave open an avenue for mistakes, which when they occur are all the more annoying because, falling as they do between the manufacturer of the engine and that of the dynamo, the responsibility can never be definitely placed on one or the other. As instances may be cited solid shafts versus couplings, notably in the case of centre crank engines, where the shipping of the shaft round the country, especially if the armature be attached, is very likely to result in a sprung crank pin; the minimum size of shaft desired by the engine builder which in side crank engines at any rate is frequently objected to by the dynamo manufacturer as "too large for our standard armature spider", the responsibility for the supplying of the shaft key, the outboard bearing, the attaching bolts, for the labor of pressing on the armature, etc. Efforts have been put forth by the American Society of Mechanical Engineers to formulate such standard practice as will assure the elimination of any and all possible mistakes and misunderstandings between the customer, the electric company, and the engine builder, the reduction of costs, and thus give its members a better hold upon their present markets and a greater chance to secure new ones. Does it not behove our various Canadian manufacturers to get together along the same lines, and thus retain their natural market, which will otherwise be secured by their more enterprising competitors?

Nernst Lamp.

The Nernst lamp has long been a favorite theme for technical journals and engineering societies, but the time has now come when it will have to be taken into account as a commercial article. A number of plants in the United States have put in more or less experimental equipments during the past year, and have obtained results which will doubtless warrant large increases. Some of our Canadian companies are now making tentative purchases, and as the apparatus becomes better known among consumers they will in all probability put more and more lamps into commission. This lamp, while retaining some of the features of the arc, approaches much more closely the incandescent. The light is emitted from a conductor raised to the proper temperature, similarly to the hot filament of the latter, except that it is not enclosed in a vacuum. As opposed to the flickering of an arc it gives an absolutely steady illumination, very much resembling the usual Edison lamp. The light emitting part of the lamp, or glower as it is called, is a non-conductor until raised to a certain temperature, and to do this or start the lamp, an auxiliary circuit containing the heater is provided, which is cut out as soon as the glowers get hot enough to let current flow through them. In addition to the steadiness and pleasing color qualities of the light, it accomplishes a great step forward in efficiency, which is about 1¾ watts per candle, as against 3 for the incandescent type. It also has the further merit of being easier to build for 220 volts than 110, which, much as it is desired, is not yet true of the arc or incandescent types. It is usually manufactured to-day in sizes ranging from one glower, rated at 50 c. p. and consuming 88 watts, to 6 glowers producing 300 c. p. and taking 530 watts. The life of the glowers, which are very easily renewable, something after the style of the carbons in an arc lamp, varies considerably, being materially affected by voltages higher than normal, the same as is an incandescent filament. In Europe the apparatus has been developed for use on direct current circuits only, while on this continent the practice has been entirely opposite, the equipment at present on the market being adapted for nothing but alternating currents. The average life appears to be somewhere about 800 hours for 60 cycles, which is decreased by 50 per cent. for 25 cycles, and increased approximately a corresponding amount for frequencies of 125. In appearance the lamp is very similar to a small arc lamp, though equipped with a standard Edison incandescent base, and furnished with a closed base globe, adopted for either indoor or outdoor use, forming a very pleasing combination.

BRITISH COLUMBIA ELECTRIC RAILWAY.

The report of the directors of the British Columbia Electric Railway Company, submitted at the annual meeting on January 21st., covered operations of fifteen months, from 1st. April, 1901, to 30th. June, 1902. For this period the gross receipts were $691,487, being $80,369 in excess of those for the corresponding previous period. The working expenses were $426,760, an increase of $52,929, and the net earnings were $264.727, an increase of $27,440.

The chairman recommended certain improvements, such as the renewal of six miles of track with heavier metal on the Victoria division, increased rolling stock, and the erection of rolling stock building yards. It was stated that a considerable amount of profitable freight business had to be refused during the past six months.

The Electrical Construction Company, of London, Ont., have installed an electric motor in the printing office of the Observer, Sarnia, Ont. It is a 500 volt machine operating at 1,500 revolutions per minute.

MOMENTUM RAILWAY BRAKES.

Since the general introduction of electric transit, the need of a more efficient brake than the old style hand brake has become increasingly apparent. Cars have increased in size and weight, larger loads are carried, speeds have increased, and a motorman makes a far larger number of stops per day than did the driver of an old time horse car. All this means a greater demand on the strength and physical energy of the motorman under all conditions, and it means, further, that under some conditions the hand brake is entirely incompetent to prevent disaster.

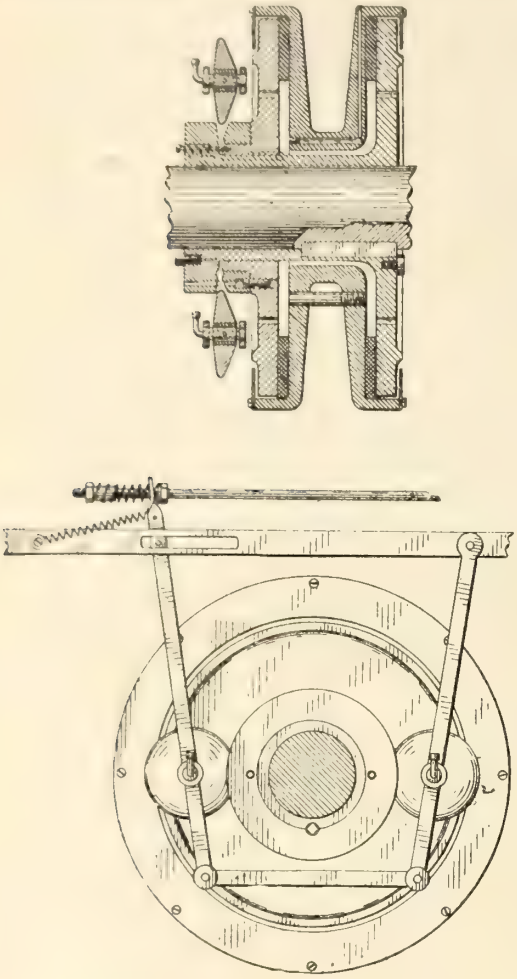

Fig. 1.—Cross-Section of Momentum Brake.

Various devices have been introduced to provide more efficient braking power. Some have increased the braking leverage, but, necessarily, this means loss of time in applying the brakes.

Air brakes have had considerable vogue. In individual compressor air brake systems each car is equipped with an electrically operated compressor. Such air brakes use expensively generated and transmitted power, which can often be ill spared when a car is a long distance from the power house. Storage air brake systems mean the maintenance of several compressor plants at different stations, and the loss of time in replenishing the storage tanks of cars, particularly of those operating in sections on which the stops are frequetn.

The principle of the momentum brake is worthy of explanation. By a momentum brake is meant one which utilizes the power stored up in the car's momentum to apply the brakes for a stop. This power has to be dissipated in some way before the car can stop, and it is evidently a most rational proceeding to use part of this power in applying the brakes instead of trying to dissipate it all in the form of friction between the brake shoes, the wheels and the rails.

The brake made by the Momentum Brake Company, Limited, 34 Victoria street, Toronto, under the T. E. McCollum patents, is a momentum brake which has proved successful in practice. As will be seen by referring to the illustrations, and particularly to Fig. 1, the brake comprises a friction disk formed on a sleeve secured to the axle, a second friction disk sliding with a feather key on the sleeve, and a flanged drum journaled on the sleeve between the friction disks. On this drum is wound the chain connected to the brake levers. On the disks are secured annular friction surfaces of compressed wood fibre which engage the sides of the drum. The flanges of the drum overlap the friction disks and have annular plates secured to them to exclude dust and form an oil bath for the friction surfaces.

On the end of the hub is secured a bevel sided collar, and the hub of the movable friction disk is similarly beveled to form with the collar a V-shaped grove, with which the taper wheels shown may be engaged to force the friction disks and drum into contact. The method of supporting and applying the taper wheels will be understood from the illustration. Attention must be called, however, to the coil compression spring arranged between the taper wheel lever and the horizontal rod which is operated by chain from the ordinary brake staff. This spring is claimed to ensure the elastic application of the brake in such a manner as to avoid jarring and skidding.

With this brake there is a direct mechanical connection from the motorman's hand to the wheels, and he can actually feel what the latter are doing, so that he can always apply just the amount of force to the brakes necessary to give the best braking effect without skidding, and in this the spring aids, as it prevents the actual hard and fast locking of the wheels.

In applying the brake the manufacturers claim that about a quarter turn of the brake staff suffices to bring the friction surfaces of the brake into contact, after which a third of a revolution of the drum applies the maximum power of the brake. This makes the brake very effective in emergencies. But, as the effective friction of the friction surfaces depends entirely on the power applied by the motorman, the stops may be made as easy as may be desired for service purposes.

In this connection it is important to note that the friction surfaces of the brake are set as far from the axle as possible, while the winding surface of the drum for the brake chain is as close as possible. This not only increases the powsr of the brake owing to the great leverage of the friction surfaces, but makes the brake steadier in action and responsive to small variations in the power applied to it by the motorman.

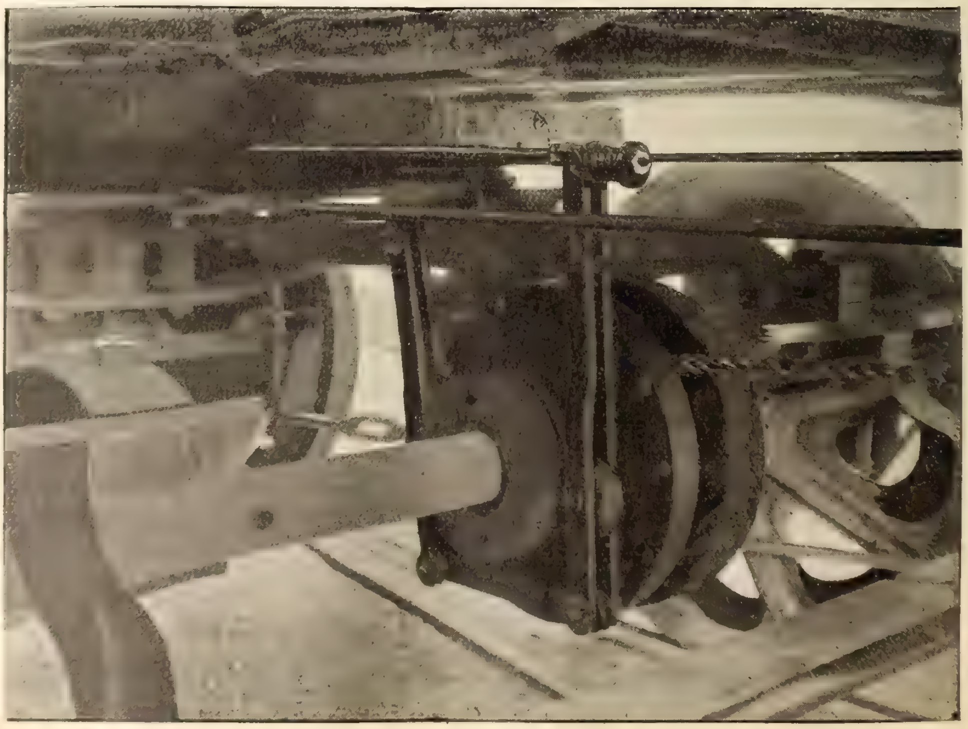

Fig 2. – Momentum Brake Mounted on Spare Axle of a Double-Truck 22-Ton Car.

The brake complete weighs 280 pounds. Its greatest diameter is 10 inches, and its greatest width 8 inches. The width can, however, be materially reduced to suit special cases. The annular fibre friction surfaces are 2½ inches wide and present 236 square inches of friction surface. The taper wheels are of steel, 5½ inches in diameter. The brake goes on the axle beside the motor and is easily fitted to any car.

One of the most important features of the brake does not show in the cuts, viz., the device for preventing "back-roll."

It has been urged against momentum brakes that, if the brake be released and then re-applied while the car is on a grade, it will not grip to hold the car until the chain has been unwound from the drum and then rewound the reverse way. This "back-roll" might amount to nearly eight feet. In the McCollum brake the connections between the brake mechanism and the brake staff are said to be so arranged that under the circumstances described the motorman, by merely reversing the movement of the brake staff, is enabled to catch the car and hold it before "back-roll" commences.

The brake has been severely tested in actual service. The Toronto Railway Company have twenty-three on their cars; the Niagara, St. Catharines and Toronto Railway Company are using five, and the International Transit Company, of Sault Ste Marie, Ont., have equipped their entire system with these brakes.

One brake in constant use for 15 months in Toronto is claimed to have cost only $2.50 for oil, repairs and maintenance, and to have given entire satisfaction to the company and to the men handling it, and the car has never been in the shops with flat wheels. The cost of the brake is comparatively small.

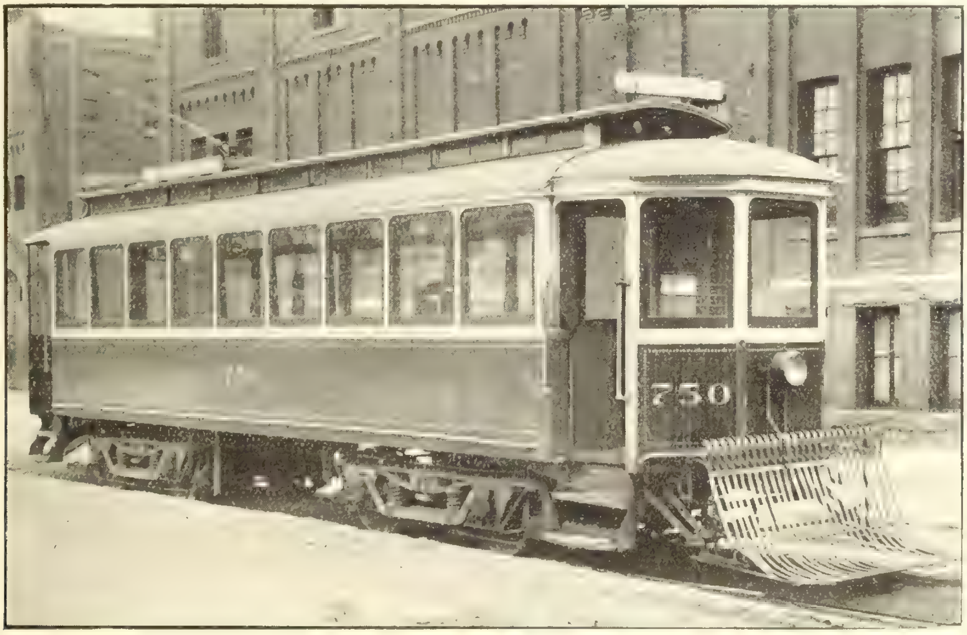

FIG. 3.—DOUBLE-TRUCK FOUR MOTOR CAR, EQUIPPED WITH MOMENTUM BRAKE.

ELECTRIC PLANT AT ANDREWSVILLE.

Andrewsville, also known as "The Flats," is a small village situated on the Rideau River, fifteen miles east of Smith's Falls and two and one-half miles below Merrickville. At Andrewsville there are three Government locks, also two Government dams for keeping the water at a level in the canal. The Kemptville Milling Company also own a dam about one-quarter of a mile below the Government dams, which has been brought into service to furnish power for an electric plant which they have just installed. There is a ten-foot head of water operating two seventy-four inch latest improved Leffel Wheels manufactured by Madison Williams, of Port Perry. These wheels are set in a concrete flume 20x40 feet. The concrete walls are four inches thick, sixteen feet high and built on solid rock bottom.

A space under the wheels has been blasted to the depth of 10 feet by 18 by 36 feet, with an incline for the tail-water to leave the wheels. In order to be able at any time to raise the dam to secure more head, there have been placed on the water-wheels two upright shafts eighteen feet long made of six inch steel. Situated on each upright shaft is a six foot crown wheel. There is also a lay shaft thirty-six feet long, of five inch steel, with friction clutch cupplings on each wheel in order to cut any wheel out as required. There is on each lay shaft an eleven-foot wood split p lley, thirty-six inch face, manufactured by the Dodge Company, of Toronto.

The power-house is built over wheels and flume the dimensions being thirty-six by forty feet and one-storey high. The foundation for generator is built on the solid rock below flume, 18 feet high 10 by 12 feet at the top, of concrete. On this foundation has been placed a 300 k.w. three-phase generator, driven by a thirty-four inch double leather belt, and generating ten thousand volts, also a 14 k. w. exciter, which is sufficient to excite the generator and furnish direct current lights to the village of Andrewsville. The generator and all electrical apparatus was manufactured by the Canadian General Electric Company, of Peterborough. In the building is also located high potential switch-boards, ampere meters, volt meters, oil switches and lightning arrestors placed on marble panels.

From Andrewsville the power is transmitted to Kemptville over a fourteen mile transmission line, composed of three No. 6 hard drawn bear copper wires, strung on poles from thirty to thirty-five feet in length, one wire on top of poles and the other two on cross-arms. The wires are twenty-one inches apart. The insulators are of the Knowles umbrella type, sufficient to insulate for 200,000 volts. Three miles below the power house is the village of Burritts Rapids, which it is intended to light.

The pole line follows the main road, crossing the Rideau river and canal at Burritts Rapids. On the same pole line there is a metallic telephone service of two wires, transposed every five poles, for the company's use.

At Kemptville there is a brick sub-station for the step-down transformers which reduce the voltage from 10,000 to 2,300, also high potential switch-board, switches and lightning arresters and all other necessary apparatus. The sub-station is situated 100 feet from where the company have a one hundred barrel flour mill and seventy-five barrel oatmeal mill, where there have been installed two 200 horse power boilers and two corliss engines of 125 n.p. and 100 h.p., also 1,500 alternating current dynamo, which furnishes the village of Kemptville with lights, running on 2,000 volt primary and 110 volt secondary. The streets are lighted with forty 32 candle power series lamps, besides thec ommercial lighting. This latter machine is also of the Canadian General type and was installed about four years ago.

The company intends leaving their steam plant in tact for an auxiliary plant. They are also installing in the dynamo room a 100 h. p. induction motor of 2,300 volts to run the flour and oatmeal mill from the power plant at Andrewsville.

Several factories of Kemptville are anxious to obtain power and there promises to be a demand for all the available current. The chief electrician is Mr. John Maxwell, and associated with him are Mr. Rolf, of Ottawa, and Mr. James O. Hyndman. The plant is about to be put into operation.

AN ANALYSIS OF THE COMMERCIAL VALUE OF A WATER-POWER.*

By A. F. Nagle.

The writer recently testified in court as to the value of water-power per horse power per annum in a manner that may be of interest to our membership. The subject-matter has been discussed heretofore in our society, but I am not aware that precisely the same analysis has been given before. The problem is quite a familiar one to New England engineers. The river flow is assured to certain abutting parties by old legislative grants, and is usually used for power purposes. Any town or city taking water from this stream is liable for damages incurred by reducing the available power of said stream of water. The amount of power existing in the stream at each mill, expressed in horse-power per second, as well as the amount taken, or diverted, by the city, and affecting the particular mills, is a problem for hydraulic engineers which I do not take up ; but the value of the water power at each mill is a problem which I have attempted to solve. I have formulated my studies under three theorems, which I believe express the true principles under which the problem can be solved, with as much certainty as the cost of a steam-power.

Theorem 1. The value of water-power, when of ample capacity or a specific purpose, does not exceed the cost of what a competing power, steam or gas engine, can be installed and operated for at the same locality.

Theorem 2. When a water-power is insufficient for a specific purpose, due to the varying flow at different seasons of the year, and its limited amount, then its value is reduced from that established by Theorem 1, by the cost of installing and operating a steam plant to make good this insufficiency.

Table I.—Annual Cost of Steam-Power per Indicated Horse-Power.—Compound Condensing Engine.

Horse-Power.	400	500	600	700	800	900	1,000	1,200	1,500
Cost of plant per I.H.P.	$64.00	$60.00	$57.50	$56.00	$55.50	$55.00	$54.60	$54.00	$53.00
Annual interest, etc., at 10 p.c. per I.H.P.	6.40	6.00	5.75	5.60	5.55	5.50	5.46	5.40	5.30
Cost of banking (no heating), repairs, supplies, engineer, etc., per I. H. P.	7.30	7.60	7.75	7.80	7.95	7.70	7.55	7.50	7.50
Annual (3,060 hrs.) cost of coal at $4.50 per long ton per I. H. P.	12.30	11.40	10.50	9.85	9.50	9.30	9.25	9.25	9.20
Total annual cost per I.H.P.	26.00	25.00	24.00	23.25	23.00	22.50	22.26	22.15	22.00

Table II.—Annual Cost of Steam-Power per Indicated Horse-Power.—Simple Condensing Engine.

Horse-Power.	50	75	100	150	200	250	300	400	500
Cost of plant per I.H.P.	$90.00	$75.00	$65.00	$57.00	$51.00	$47.00	$45.00	$43 00	$42.00
Annual interest, etc., at 10 p.c. per I.H.P.	9.00	7.50	6.50	5.70	5.10	4.70	4.50	4.30	4.20
Cost of banking (no heating), repairs, supplies, engineer, etc., per I. H. P.	9.00	8.50	8.20	8.30	8.60	8.30	7.90	7.85	7.80
Annual (3,060 hrs.) cost of coal at $4.50 per long ton per I. H. P.	25.00	22.00	20.00	17.00	15.30	15.00	14.60	13.85	13.00
Total annual cost per I. H. P.	43.00	38.00	34.70	31.00	29.00	28.00	27 00	26.00	25.00

Theorem 3. The damages to be paid annually, or capitalized at—per cent. if made in one payment, for a given amount of diverted water-power is the value of the water-power as found by Theorem 2, plus the depreciation in the value of the remaining water-power.

The cost of power is an element in all productive industries, and whether it be a large or small element, the mill (we will call it) demands a certain amount of power, the cost of which, if a steam plant, can be calculated quite closely, probably within 10 per cent. It is the interest of the mill owner to obtain his power at the least possible cost to himself, and he stands in the position of a buyer of power before the power-producing public. Two sellers may offer him power—a steam-power producer, or a water-power producer. Because the mill owner in New England is generally also a water-power owner, does not change the relation of the power consumer to the power producer, a buyer and a seller, and for a clear understanding of this complex problem, it is absolutely necessary to separate the two parties in any analysis that may be applied to the problem under consideration.

The annual cost of steam-power per horse power, including every item except land, can be calculated by an experienced engineer for any particular locality with reasonable accuracy. In Tables I. and II. I have given my estimates of engine plants ranging from 50 horse-power to 500 horse-power, single-condensing engines; and from 400 horse-power to 1,500 horse-power compound-condensing engines located along the Blackstone River, New England. These estimates are generally large, but as the items appear both in the minuend and subtrahend of the calculation, the remainder, resulting in the value of the water-power, is not so seriously affected thereby. The result, however, of these large figures for steam-power is to increase the value of the water-power. The items comprising the tables are all so well known to engineers that it is needless for me to comment upon them. Nor is it so much my purpose to establish the accuracy of these particular items, or their results, as it is to establish a principle, or method, of calculating the value of a water-power for power purposes, and thereby take the problem out of the domain of prejudiced guesswork.

Theorem 1 is almost a self-evident proposition. No mill owner as a buyer of power will pay more for water-power than he can install and operate a steam plant for. He would not even give as much as that, because if he had water-power only, he would have to install a boiler plant for heating and other auxiliary uses; while if he had a steam plant, he could supply himself with this additional steam at a comparatively small cost. For present purposes, however, I shall neglect this fact.

Theorem 2 is not quite so obvious. Very few water-powers are of sufficient power to supply the large mills they drive with ample power every day in the year. At times there is an excess, and at other times it is quite insufficient. It is at this point that a clear understanding must be had of the relation of the mill owner to the water-power owner. It is not the business of the mill owner to meddle with the problem of this varying and insufficient water supply. That difficulty belongs entirely to the water-power owner. In order to make the water-power commercially available, in order to give it any value at all to the purchaser of power, in order to give it what it has been pleased to call "a market value," "a commercial value," he must supplement the fluctuating water-power with steam-power. The maximum possible price obtained for the combined steam and water-power has been fixed by the cost of a single steam plant. Hence the less the steam-power costs him the more he will get for his water-power. This will be more fully illustrated by detailed calculations hereafter.

Theorem 3. This theorem is perhaps more theoretical than practical, for in few cases is the quantity of water diverted from a stream sufficiently large to affect perceptibly the quantity remaining. It is, however, a fact that repeated diversions constantly diminish the value of the remaining power; and it is proper that this depreciation of the remaining power should be paid for at each diversion. This would seem to be a principle of equity, and I have investigated the application to a particular case upon a rather extravagant hypothesis.

To illustrate the practical application of the theorems here advanced, one mill and its power diagram has been selected from the testimony in the suit. The river flow in horse-power per minute for every month in the year is established at the mill by hydraulic engineers employed in the suit. The amount of the diverted power at the mill is also given by said engineers, but is too small to appear in the diagram, Fig. 1. The amount of power required to operate the mill, and the wheel capacity, are given by the mill owner. Referring to Fig. 1, the power of the river flow is seen to vary greatly. This mill requires an average of 900 horse-power per annum. The water wheel is of only 743 horse power, and the mean annual water-power is 690 horse-power, requiring a steam-power of 210 horse-power to give the 900 horse-power to the mill. The low stage of the river is such that a 370 horse-power steam plant will be required at times.

MAXIMUM EFFICIENCY OF A WATER-POWER PLANT.

Referring again to Fig. 1, it is quite evident that a large wheel-power would have been conductive to a greater value of

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[*] Slightly condensed by the Engineering Record from a paper read before the American Society of Mechanical Engineers.

the water-power. For the purpose of ascertaining the greatest value of a water-power by the rules laid down in this paper, let us assume that the minimum flow is as shown in the figure. In that case water of 530 horse-power would be supplied every day in the year, and if it could be brought about that a mill required just that amount of power, the water-power would be worth $25

TABLE III.—WALLEY FALLS COMPANY.

Required mill-power	900	H.-P.
Average water-power	690	"
Average steam-power	210	"
Maximum steam-power	370	"
Time engine runs	12	months
Full annual cost of 900 H.-P.C.C. plant at $22.00		$20,250
Annual interest, etc., 370 H.-P.S.C. at $4.40	$1,628	
Annual supplies, etc., 370 H.-P.S.C. at $7.85	2,904	
Annual coal, 210 H.-P.S.C. at $14.00	2,940	
Total cost of 210 H.-P. steam	$7,472	7,472
Cost per H.-P.	35.60	
Value of 690 H.-P. water		$12,778
Value of 1 H.-P. water	$18.52	

per horse-power (see Table I.) and the water owner would receive a revenue of $13,250 per annum. On the other hand, if the mill still requires 900 horse-power, and only 530 horse-power wheel-power were available, then the calculation would stand as in Table IV.

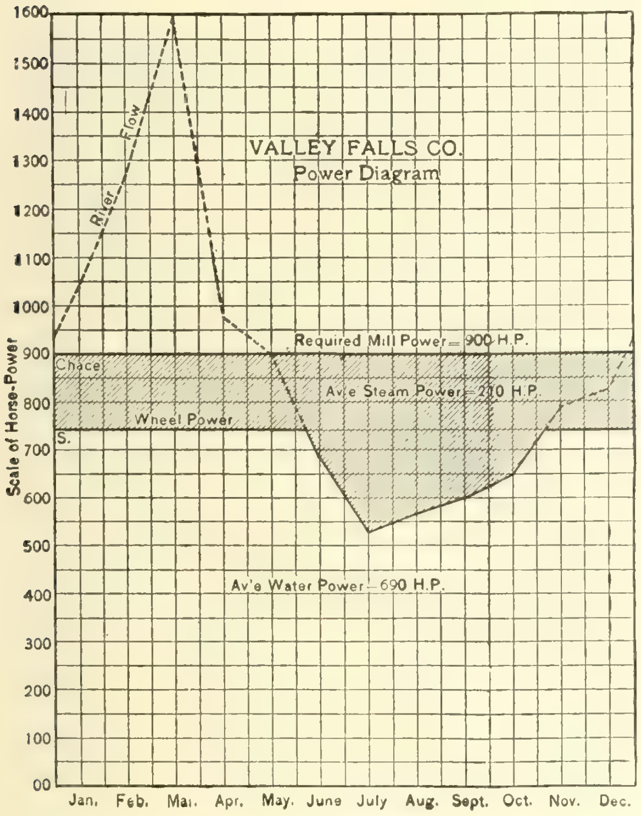

FIGURE 1.

TABLE IV.

Required mill-power	900	H.-P.
Average water-power	530	"
Average steam-power and maximum	370	"
Full annual cost of 900 H.-P.C.C. plant at $22.50		$20,250
Annual interest, etc., H.-P.S.C. at $4.40	$1,628	
Annual supplies, etc., 370 H.-P.S.C. at $7.85	2,904	
Annual coal, 370 H.-P.S.C. at $14.00	5,180	
Total cost of 370 H.-P. steam	$9,612	9,612
Cost per H.-P.	26.00	
Value of 530 H.-P. water		10,538
Value of 1 H.-P. water	$19.88	

Now let us go a step further, and under the same conditions and requirements put in a 900-horse-power-wheel. Then the calculations will stand as in Table V.

TABLE V.

Required mill-power	900	H.-P.
Average water-power	764	"
Average steam-power	136	"
Maximum steam-power	370	"
Time engine runs	7½	months
Full annual cost of 900 H.-P.C.C. plant at $22.50		$20,250
Annual interest, etc., 370 H.-P.S.C. at $4.40	$1,628	
7½ mos'. supplies, etc., 370 H.-P.S.C. at $7.85	1,815	
Annual coal, 136 H.-P.S.C. at $14.00	1,904	
Total cost of 136 H.-P. steam	$5,347	5,347
Cost per H.-P.	39.32	
Value of 764 H.-P. water		14,903
Value of 1 H.-P. water	19.54	

Hence, we see that a mill requiring 900 horse-power with a river flow as indicated by Fig. 1, can be supplied with power by water-power owner in one of two extreme ways. If he puts in only 530 horse-power wheels running every day in the year at this power, he will receive $10,538 net for his water, but he must spend $9,612 for steam-power in order to obtain this amount for his water. If, on the other hand, he would put in a 900-horse-power wheel and spend $5,347 for steam, albeit it costs at the rate of nearly $40 per horse-power, he will receive nearly $15,000 per annum, or $19.54 per horse-power.

MONTHLY VERSUS ANNUAL AVERAGES.—There is some question as to the accuracy of determining the average annual value of the water-power by the annual average, or calculating it separately for each month in the year. I have made an estimate of said values as applied to Fig. 1, by monthly estimates, and compared it with the annual average which has been used throughout these calculations. I have also introduced a corrected value of coal due to underloading of the engine, and embodied the result in Table VI.

TABLE VI.

Power required at mill	900	H.-P.
Cost of steam H.-P. per annum		$22.50
Cost of coal per H.-P. per annum		9.30

Monthly H. P.	Cost of steam per H.-P. uncorrected.	Cost of coal per H.-P. corrected for underload.	Cost of steam per H.-P. corrected.	Value of Water per H.-P. based upon Col.4.
160	$42.32	$17.50	$45.82	$17.47
160	42.32	17.50	45.82	17.47
160	42.32	17.50	45.82	17.47
160	42.32	17.50	45.82	17.47
160	42.32	17.50	45.82	17.47
220	34.60	16.00	36.62	17.94
350	27.00	14.00	27.00	19.67
330	27.72	14.00	27.73	19.47
300	29.11	14.50	29.61	18.95
240	32.89	15.50	34.38	18.18
160	42.32	17.50	45.82	17.47
160	42.32	17.50	45.82	17.47
210	37.30	16.38	39.67	*18.04
210	35.60	14.00	.....	†18.52

*Annual average by monthly estimate. †Annual average by yearly estimate.

Column 1, Table VI, is the average monthly steam-power, column 2 is the cost of this steam-power as found by preceeding methods, column 3 is the corrected cost of coal per annum for an underloaded engine, column 4 is the annual cost of steam-power based upon coal value in column 3, and column 5 is the final value of water-power based upon steam cost in column 4.

It will be seen that while the cost of steam-power (210 horse-power) based upon a yearly average is $35.60 per horse-power, it is increased to $37.30 per horse-power if made upon a monthly basis; and if also corrected for coal, becomes $39.67 per horse-power; and the value of water-power is reduced from $18.52 to $18.04, which is less than one would have supposed it to have been, and yet it is the correct way to pursue.

SUCCESSIVE DIVERSIONS.—The amount of water diverted is usually very small in proportion to the total quantity in the river. To illustrate in detail the manner of calculating the value of the water-power per horse-power per annum when large quantities of water are taken at several intervals instead of all at one time, I have applied the calculation to a water privilege substantially like that of the Valley Falls Company, Fig. 1, where, say, 100 horse-power is taken at each interval, until it is all taken. The results are given in Table VII.

TABLE VII.—FIRST CASE, ORIGINAL CONDITION.

Required mill-power	900	H. P.
Average water-power	700	"
Average steam-power	200	"
Maximum steam-power	400	"
Time engine runs		12 mos. always
Full annual cost of 900 H.-P. C.C. at $22.50		$20,250
Annual interest, etc., 400 H.-P.C.C. at $6.40	$2,560	
Annual supplies, etc., 400 H.-P.C.C. at $7.30	2,920	
Annnal coal, 200 H.-P.C.C. at $12.30	2,460	
Total cost of 200 H.-P. steam	7,940	7,940
Cost per H.-P.	39.70	
Value of 700 H.-P. water		12,310
Value of 1 H.-P. water	17.60	

SECOND CASE.

Required mill-power	900	H. P.
Average water-power	600	"
Average steam-power	300	"
Maximum steam-power	500	"

Full annual cost of 900 H.-P. as before		$20,250
Annual interest, etc., 500 H.-P. C.C. at $6.00	$3,000	
Annual supplies, etc., 500 H.-P. C.C. at $7 60	3,800	
Annual coal, 300 H.-P. C.C. at $11.40	3,420	
Total cost of 300 H.-P. steam	10,220	10,220
Cost per H.-P.	34.07	
Value of 600 H.-P. water		10,030
Value of H.-P. water	16.72	

THIRD CASE.

Required mill-power	900 H.-P.	
Average water-power	500 "	
Average steam power	400 "	
Maximum steam-power	600 "	
Full annual cost of 900 H.-P. as before		$20,250
Annual interest, etc., 600 H.-P. C.C. at $5.75	$ 3,450	
Annual supplies, etc., 600 H.-P. C.C. at $7.75	4,650	
Annual coal, 400 H.-P. C.C. at $10.50	4,200	
Total cost of 400 H.-P. steam	12,300	12,300
Cost per H.-P.	30.75	
Value of 500 H.-P. water		7,950
Value of 1 H.-P. water	15.90	

A summary of cost of steam-power and value of water-power at seven successive divisions, the required mill-power remaining at 900 horse-power, is given in Table VIII.

TABLE VIII.

Cost of Steam-power.			Value of Water-power.		
Amount.	Per H.-P. annual.	Total cost.	Amount.	Per H.-P. annual.	Total value.
1	2	3	4	5	6
200 H.-P.	$39.70	$7,940	700 H.-P.	$17.60	$12,310
300 "	34.07	10,220	600 "	16.72	10,030
400 "	30.75	12,300	500 "	15.90	7,950
500 "	28.61	14,305	400 "	14.86	5,945
600 "	27.50	16,500	300 "	12.50	3,750
700 "	26.27	18,390	200 "	9.30	1,860
800 "	24.10	19,320	100 "	9.30	930
900 "	22.50	20,250	0 "	....	....

In addition to the value of the diverted water-power, there is also a depreciated value to the remaining water-power. This is easily found by finding the value of the water-power before and after diversions, and the difference between the two, multiplied by the amount remaining, is the amount to be paid for depreciation. Table IX gives these amounts, as well as the direct damages for 100-horse power diverted at seven intervals.

TABLE IX.—Annual Cost of 100 H.-P. Diverted Successively, and Depreciation of Remaining Power for Seven Periods. Required Mill-power always 900 H.-P. Cost thereof at $22.50=$20,250 per Annum.

Amount of water-power.	Value of water per H.-P.	Difference.	Cost of 100 H.-P.	Water-power remaining.	Amount of Depreciation.	Total Cols. 4 and 6.	Cumulative Amount.
1	2	3	4	5	6	7	8
700 H.-P.	$17.60	0.88	$1,760	600 H.-P.	$528	$2,288	$2 288
600 "	16.72	0.82	1,672	500 "	410	2,082	4,370
500 "	15.90	1.04	1,590	400 "	416	2,006	6,376
400 "	14.86	2.36	1,486	300 "	708	2,194	8,570
300 "	12.50	3.20	1,250	200 "	640	1,890	10,460
200 "	9.30	0.	930	100 "	....	930	11,390
100 "	9.30	....	930	....	....	930	12,320
Total....	....	....	$9,618	....	$2,702	$12,320	....

The accounts of the water-power owner will, therefore, stand as in Table X.

TABLE X.

Receives annually from the mill owner for 900 H.-P.	$20,250
Before any water is taken, expends annually for steam-power (Table VIII. Column 3)	7,940
Leaving a net income of	$12,310
1st—When 100 H.-P. are taken at $17.60 plus depreciation, receives from mill owner	$20,250
100 H.-P.—From city, (Table IX, Column 8)	22,288
A total income of	$22,538
Expends for steam-power (Table VIII, Column 3)	10,220
Net income	$12,318
2nd—Second diversion at $16.70 plus depreciation, receives from mill owner	$20,250
100 H.-P.—From city ($2.288+$2,082)	4,370
A total income of	$24,620
Expends for steam (Table VIII, Column 3)	12,300
Net income of	$12,320
3rd—From mill owner	20,250
From city	6,376
100 H.-P.—Total income of	$26,626
Cost of steam as above	14,305
Net income	$12,321

It will be seen that the analysis proves itself correct in every instance. The water-power owner, whose income was $12.320 per annum before any diversion of water took place, always receives the same figure, whether much or little, or all be taken at intervals or all at one time.

It is sometimes admitted by engineers on the other side that my analysis for ascertaining the value of water-power may be correct, but that diverted water power must be paid for at what it costs to take its place. Thus the value of the water-power is $18.52, but the cost of its auxiliary steam-power is $35.60 per horse-power, and they would thus maintain that that should be the amount to be paid for diverted power. This seems very plausible, and it is a fallacy not easily seen through by engineers, attorneys or courts; but it is all a fallacy nevertheless. It is a fallacy in the first place, because if the theory were correct, it would lead to absurd conclusions. Thus, if the entire water-power of 690 horse-power were taken and paid for at the rate of the cost of its auxiliary steam-power, namely, $35.60, the damages would be $24.564, which exceeds the cost of an entire 900-horse-power steam plant.

It is fallacious, in the second place, because it makes the damages to an imperfect or insufficient water-power greater than is conceded to be the value of a perfect or complete one! that is, it is claimed that $35.60 per horse-power should be paid for a defective water-power when $22.50 per horse-power will pay for a perfect power.

It were perhaps better for a clearer understanding of this problem if the cost of furnishing the auxiliary steam-power were not reduced to its equivalent cost per horse-power at all, and simply to say that it costs the water-power owner so much money to supply the natural defects of his water-power, which expense he mustto go in order to find a market for his water-power. The question of cost of steam-power is only entered into in order to ascertain the true value of the water-power, and it is the interest of the water-power owner to make it as little as possible. As a matter of fact, for the small diverted power, it costs him only the price of coal, say $14 per horse-power per annum, while he is paid, under this analysis, $18.52 per horse-power. It is held, however, that if he is paid only for the coal consumed, he is paid nothing for his plant, etc., and that the defendant has no right to use that plant.

The maintenance of this auxiliary steam plant is a necessity and a burden entirely upon the shoulders of the water.power owner, in order to make his water-power worth its maximum to himself, and that maximum value of water-power the defendant is willing to pay.

Two cases are at work which make this auxiliary steam-power disproportionately expensive : First, the natural fluctuation of the river flow ; and second, its insufficiency for the uses of the mill. Neither of these causes are the fault of the defendant, except in the latter case, by the amount of diversion. It is not the fault of the defendant that the auxiliary power costs what it does, and he should therefore, not be made to pay for it. When he has paid the market or commercial value of the water-power plus the damage inflicted upon the balance of remaining power, he has met the requirements of equity.

Theorem 3 expresses the true basis upon which the damages should be paid. Under the analysis here laid down the water-power owner is not injured one dollar whether much or little water be taken, for he is assured precisely the same annual income he received before the city trespassed upon his rights as after. In the suit referred to, however, the amount of power diverted is so small compared with the river flow or total mill power that I neglected to compute this item.

A committee of the city council of Sherbrooke, Que., has been appointed to interview the Sherbrooke Water & Power Company relative to the purchase of their plant.

POWER PROJECT IN MEXICO.

Canadian capitalists have just organized the Mexican Light & Power Company, for the purpose of establishing an extensive electric plant about eighty miles from the city of Mexico. Those interested in the project include Messrs. B. F. Pearson, of Halifax, Hon. George A. Cox, William Mackenzie and E. R. Wood, of Toronto, and James Ross, of Montreal.

The company is incorporated under the laws of Canada and has an authorized capital stock of $12,000,000. It is understood that Mr. James Ross has the largest interest in the concern and that he and his associates will do about two-thirds of the underwriting. The construction of the plant will require about two years and the quantity of power generated will be about 40,000 h. p.

THE SHAWINIGAN TRANSMISSION PLANT.

On Saturday, February 7th, the Shawinigan Water & Power Company successfully started their power transmission plant between Shawinigan Falls and Montreal. The transmission line, which is of aluminum cable, is a fraction of over eighty-four miles in length. The transmission is at 50,000 volts 30 cycles. The line has a maximum capacity of 8,000 horse-power. The apparatus at present installed is capable of delivering 2,500 horse-power, and additional apparatus is being put in as rapidly as possible for 2,500 horse-power more. The step-up and step-down transformers and switchboard apparatus were furnished by the Westinghouse Electric & Manufacturing Company, and the synchronous frequency chargers for changing from 30 to 60 cycles by the Bullock Electric Company. This apparatus was all set up ready for operation seven months from the date of the order for it. The 50,000 volt line insulators were furnished by the R. Thomas & Sons Company, of East Liverpool. The aluminum cable was supplied by the Pittsburg Reduction Company.

The station buildings for the transmission were designed by Mr. Wallace C. Johnson, chief engineer of the Shawinigan Water & Power Company, who also had in charge the carrying out of the construction work. The transmission was laid out and the construction directed by Mr. Ralph D. Mershon, consulting engineer for the Shawinigan Company.

MIDLAND ELECTRIC LIGHT ARBITRATION.

The arbitrators appointed to value the plant of the Midland Electric Light Company have given their award. The town offered $8,000 for the plant, while the company asked $18,000. The valuation fixed by the award is $9,630. The result of this arbitration is most unsatisfactory to the owners of the plant, as it was believed that the award would not be less than $16,000. The circumstances of the case are of interest. Mr. James Playfair, the owner of the plant, was some years ago requested to install the plant to accommodate the Council, and after risking his money and bringing the plant to the point where it had become a paying investment, it now becomes the property of the Corporation at a valuation little above that of scrap. The case was argued and conducted by Mr. William Steers, a well-known barrister of Lindsay, who was ably assisted by an experienced expert. It is claimed that some of the evidence submitted on behalf of the Corporation was extremely contradictory.

The plant consists of a 200 k.w. T. H. alternator (new), one 35-light Wood arc dynamo, 19 street lamps, 16 private arc lamps, and some 2,000 lights in transformers, mostly C. G. E. and S. K. C., also two engines, boiler, pumps, etc. There is a large overhead construction besides. The business of the company is quite large, and as Mr. Playfair has been one of the moving spirits in building up the town of Midland, it was expected that more liberal treatment would have been received.

THE TORONTO-NIAGARA POWER COMPANY.

The Ontario Government has passed an order-in-council granting a franchise for the development of power at Niagara Falls to the Toronto-Niagara Power Company, at the head of which is Mr. Frederic Nicholls, general manager of the Canadian General Electric Company, Mr. William Mackenzie, president of the Toronto Street Railway Company, and Lieut.-Col. H. M. Pellatt. The terms of the agreement have not yet been made public.

The application for a franchise was opposed by the Canadian Niagara Power Company, but the Niagara Falls Park Commissioners recommended that the franchise be granted and the government agreed to the application. Mr. J. W. Langmiur, chairman of the Niagara Falls Park Commission, is quoted as saying that Niagara Falls is capable of producing over 5,000,000 h.p. of electrical energy, and that less than 4 per cent. is as yet harnessed.

The new company are now calling for tenders for the construction of a timber crib coffer dam in the Niagara river near Tempest Point, and evidently propose to carry to completion their proposed works at the earliest possible moment. Mr. Frederic Nicholls, of Toronto, is general manager of the company, and Mr. Hugh L. Cooper, of New York, chief engineer.

THE WINNIPEG GENERAL POWER COMPANY.

A company was recently organized in Winnipeg to be known as the Winnipeg General Power Company. The company propose to develop a waterfall on the Winnipeg river near Lac du Bonnet and to transmit electric power to Winnipeg, a distance of fifty-five miles. The preparatory work has already been commenced. The river will be dammed by a structure 400 feet long and 20 feet high, and it is intended that the initial development shall be 10,000 h. p. The site is said to be an ideal one for the generation of power, and no doubt a modern plant will be installed. The pole line will cross the municipalities of Brokenhead and Springfield in a direct line.

The company expect to supply power for operating the street railway system, the waterworks, the Ogilvie mills, and other establishments. Mr. J. F. Mackenzie, manager of the company, has opened an office in the Canada Life Block, Winnipeg. Mr. H. L. Cooper is chief engineer, with Messrs. Hirt and Brown as assistants.

Mr. A. F. Gerald, of Fairfield, Maine, has been looking over the ground at Charlottetown, P. E. I., with a view to building an electric railway.

THE TORONTO RAILWAY COMPANY.

At the annual meeting of the Toronto Railway Company, held on January 21st, a satisfactory statement of the year's business was presented. The gross earnings amounted to $1,834,008.37, as compared with $1,661,017.50 in the previous year. The net earnings were $810,547.05, as compared with $603,405.40. That the financial statement did not show a larger net revenue is accounted for mainly by the higher prices paid for material used in maintenance and repairs, by the abnormally high price of coal, a large increase in wages of employees, and a large outlay of money occasioned in the detection and punishment of systematic thieving.

New Office Building to be Erected by the Canadian General Electric Company at Corner of King and Simcoe Streets, Toronto.

A comparative statement shows that the gross earnings have grown steadily for the past ten years. Operating expenses and net earnings have likewise increased. The percentage of operating expenses to earnings was heavier last year than in any previous year with the exception of 1893. The figures for ten years are as follows: 1893, 59.07; 1894, 54.0; 1895, 49.3; 1896, 50.9; 1897, 48.8; 1898, 47.4; 1899, 48.8; 1900, 51.0; 1901, 51.6; 1902, 55.3. It will be seen that the operating expenses in proportion to earnings reached the lowest point in 1898.

The number of passengers carried for ten years is as follows: 1893, 21,215,010; 1894, 22,609,338; 1895, 23,353,228; 1896, 23,537,911; 1897, 25,271,314; 1898, 28,710,388; 1899, 31,826,940; 1900, 36,061,867; 1901, 39,848,087; 1902, 44,437,678.

The directors declared during the year four quarterly dividends of 1¼ per cent.

The old board of directors and officers were re-elected as follows: President, William Mackenzie; Vice-President, James Ross; Hon. Geo. E. Cox, Frederic Nicholls, W. D. Mathews, H. M. Pellatt, James Gunn; E. H. Keating, manager; J. C. Grace, secretary-treasurer.

THE OTTAWA ELECTRIC RAILWAY COMPANY.

The annual meeting of the Ottawa Electric Railway Company was held at the head office, Ottawa, on January 26th. The statement showed that during the calendar year of 1902 7,097,232 passengers were carried, which was a slight decrease as compared with the previous years, due largely to the cold, wet summer. Four quarterly dividends of two per cent. each were declared.

The following directors were elected: Messrs. T. Ahearn, G. P. Brophy, Peter Whelan, W. Y. Soper, Thomas Workman, Alexander Lumsden and Hon. George A. Cox. At a subsequent meeting of the directors, Mr. T. Ahearn was re-elected president, Mr. Peter Whelen vice-president, and Mr. James D. Fraser secretary-treasurer.

The annual meeting of the Sherbrooke Gas & Water Company was held at Sherbrooke, Que., on January 29th. It was stated that the new dam which was built last fall would provide 2,400 nominal horse power. After the election of directors, Mr. Justice White was re-elected president and Mr. F. P. Buck vice-president.

The annual report of Mr. Champagne, boiler inspector for Montreal, shows that more boilers were constructed last year than ever before in one year, also that no boiler explosions occurred. The following figures are given: Boilers condemned as unsafe, 19; boilers found imperfect, 119; boilers erected during the year, of which 26 were second-hand, 70; notice of inspection served, 209; certificates issued, 460.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, February 9th, 1903.

The Finance Committee of the City Council have, for the time being at any rate, rejected the request of the Fire Committee for an appropriation of some $5,500 for the establishment of an electric inspection bureau for the inspection of interior and exerior wiring. The subject, however, is by no means dead, although the published statement that the Fire Underwriters netted a clear profit of 20 per cent. on last year's business may keep it in a trance for a while, showing as it does that the amounts lost from genuine electrical fires cannot be so very large.

The Lachine Rapids Company were assisting the Montreal Light, Heat & Power Company during the repairs to the latter's dam at Chambly, it is said to the extent of 3,500 h. p., but lately owing to price quibbles this quantity has been materially cut down. Just what is the real inwardness of the controversy in regard to power supply is one of those things no one can find out. The Royal Company claim excessive price it is said, whereas the other story is that the Lachine Company billed them at the same rates as they were charged by the Royal Company for similar service when afflicted with ice troubles a couple of years ago.

Mr. Warren, the representative of the Canadian General Electric Company, formerly with the Montreal staff, left at the beginning of the year to take up a position at the Toronto headquarters. Mr. Warren was hail fellow well met and esteemed by all his confreres, who will miss him at the old place.

A fire (the second one) which occurred lately at the Mount Royal Club, one of Montreal's most exclusive and elaborate clubs, has been chronicled in the press as being of electrical origin. Like many others, after rigid examination, there is not one iota of proof. The fire appeared to have been caused by one of the workmen engaged in the alterations to the building, being careless while smoking.

In case some one may feel that the NEWS is biased in contradicting so many alleged electrical fires in Montreal lately, you r correspondent wishes to say that he knows whereof he speaks and would only be too pleased to have some light thrown by "the other side" on the points at issue.

Surely the Montreal Street Railway can improve on the fight with snow as attempted on or about the 23rd of January. The fall was by no means as heavy as that on the famous "Ladysmith" day, which was attacked with much more spirit. Mr. Wanklyn, the manager, states that there was no lack of power; it is therefore assumed that there must be a lack of sweepers or something else. As to the use of salt, if not used too promiscuously, there are sufficient votes controlled by the public who use the street railway to oust any alderman who panders to the hackmen's union on that head.

In these days of numerous railway collisions, it would be interesting to know just why the numerous patent electric alarms devised for just such purpose have never been made use of? Are they all bad? These remarks do not appertain to the block signal systems, but to alarm bells, etc., in the cab actuated automatically by a second train being in proximity to a first either following or approaching. The United States patent records show grants for many of such.

The Shawinigan Company have all their poles erected and are busy stringing the necessary illuminum wire to supply current to the Lachine Company, who will distribute 1,000 H.P. of same in Montreal. The transmission is over 60 miles and the voltage, it is said, will be 55,000.

The first annual dinner of the Electrical Contractors' Association was held at the "Oxford" on the evening of the 14th ultimo. The event passed off most successfully. Guests from the electrical supply dealers and power companies were present. Mr. D. S. Barton replied to the toast of the Lachine Company, while Mr. J. A. Douglas spoke for the Montreal Light, Heat & Power Company. The electrical supply dealers were ably represented by Mr. C. Doutre, who replied on their behalf, as did also Mr. J. A. Dawson. Mr. G. S. Sheppard, representing the Builders' Exchange, also said a few words in regard to an important movement on hand, soliciting the co-operation of the electrical fraternity. The President, Mr. W. B. Shaw, then introduced the new president for 1903, Mr. W. H. Scott, of J. E. Scott & Company, who on taking the chair explained some of the objects of the Electrical Contractors' Association, which subject was further elaborated upon by Mr. G. S. Hill, the Secretary. Some songs were then contributed, and after further enjoyment the proceedings were closed by singing "God Save the King."

SUBURBAN ELECTRIC RAILWAYS.

Considerable activity is at present being manifested in different sections regarding the reaching out of existing street rai ways for suburban traffic. The Hamilton-Ancaster route is still in embryo, with several projected routes. The Galt line is being completed to Puslinch lake and the Guelph line is being brought down to meet it at the lake. The line from Preston to Berlin will shortly be running. The Berlin-Waterloo line is now running to Bridgeport with hourly service. There is a 20-minute service between Berlin and Waterloo.

Preston seems destined to be the hub of electricity for a district fifty miles around. They have already connections with Hespeler, Galt and Berlin, with prospects of getting to Guelph in the near future. The Galt, Preston & Hespeler Railway, of which Mr. P. J. Clemens is manager, and Mr. Ed. Haller the assistant electrician, expect to take power from the Cataract Power Company at DeCew Falls or from Niagara Falls, as the power generated at their power house at Preston is limited. They have two heavy freight motors now running. In the power house is one General Electric generator, 650 revolutions, 550 volts, 150 h.p., 60 cycle, and one Westinghouse generator, speed 750, 550 volts, 100 h.p.; two tandem compound Wheelock engines, made by Goldie & McCulloch, 150 h.p. each; one Northey feed pump, three Goldie & McCulloch boilers, 80, 100 and 80 h. p. They run a service hourly from each end in winter and half-hourly in the summer months. Saturday afternoons and holidays the service is doubled.

SPARKS.

The London Engine Supplies Company, Limited, of London, Ont., has been incorporated, with a capital of $40,000. The provisional directors are Messrs. F. G. Mitchell, A. M. Smart and John Jones.

The British Columbia Electric Railway Company are testing a new car fender, the invention of Mr. F. Young. It is made of stout rubber strips, stretched on an iron frame, and is so constructed as to enable the motorman to either raise or lower it by a lever inside the car.

Mr. H. M. Rumball, of London, Eng., has undertaken to finance the South-Western Traction Company. This company proposes to build electric roads from Hamilton to Glencoe, Brantford, Woodstock, Ingersoll and London. Dr. McKay, of Ingersoll, is a director of the company.

The Renfrew Electric Company, of Renfrew, Ont., have declared a semi-annual dividend for the latter half of 1902 at the rate of 6 per cent. per annum. Officers have been re-elected as follows: President, Mr. A. A. Wright, M. P; vice-president, Mr. A. H. Hough; secretary, Mr. I. H. Wright.

The Canadian General Electric Company have had plans prepared for a magnificent building to be erected on the old Upper Canada College Grounds, King St. west, Toronto. Although no official announcement has been made, it is understood that the building will be used largely for warehouse and show-room purposes.

The arbitrators have fixed the price to be paid by the town of Gravenhurst, Ont., for the electric light plant owned by Mr. R. Fielding at $18,012. The award also places the cost of the arbitration on the town, which will make a grand total of $22,000 to be paid for the plant. The council have decided to take over the plant in accordance with the award.

The rate war has apparently been commenced by the electric companes in Ottawa. The Ottawa Electric Company some time ago reduced its rates to the scale adopted by the Consumers' Company. The latter company then made a further reduction, the rate on February 1st to be 12 cents per 1000 watt hours, with a discount of 33⅓ per cent. for payment within 15 days after the account is presented. This is equivelent to a net rate of 8 cents per 1000 watt hours.

TRADE NOTES.

The William Kennedy & Sons Company, of Owen Sound, Ont., have just shipped six turbines to the Lachine Rapids Hydraulic & Land Company, Montreal.

Messrs. D. McKenzie & Company, 298 Richmond street, London, Ont., have issued a catalogue describing the "Eclipse" gas and gasoline engines manufactured by them.

Messrs. Veritys, Limited, London, England, have sent us a copy of their price list, No. 50, referring to the Aston Patent Electric Radiators and Radiant Heat Warming Stoves for use in house warming.

The calendars received from the Christensen Engineering Co., manufacturers of air brakes and "Teco" electrical machinery, Milwaukee, Wis., are works of art, and are certain to command attention and respect for this enterprising firm.

The Robb Engineering Company, of Amherst, N.S., have received an order from the Nova Scotia Steel Company for two vertical engines of 600 h. p. to be used for electric lighting purposes at Sydney Mines. The engines will be fitted with the new Armstrong-Corliss valve gear.

With the completion of the two wings just erected and now occupied, the Northern Electrical Mfg. Co., Madison, Wis., U.S.A., is prepared to handle the natural increase in its business, although the new quarters are already crowded. The wings are 38' x 100' 4" and 37' 8" x 100' 4" respectively, of solid brick construction.

The late Spanish-American war seems to have impressed upon the engineers of the Spanish Government the need of adopting the most modern methods in the manufacture of munitions of war. They are installing Westinghouse motors in their gun shops at Trubia, and the Spanish arsenal at Ferrol is also shortly to be equipped with a number of motors and other electrical machinery.

Most of the readers of the ELECTRICAL NEWS have to do with the purchase and operating of machinery, and should therefore be interested in learning something about the fibre pulleys manufactured by the Xylotite Manufacturing Co., of Cincinnati. In their full page advertisement in this number the company show an illustration from a photograph of one of their pulleys 52½' x 56' x 8". Full particulars regarding these pulleys may be had by addressing the company and referring to their advertisement in this paper.

An elaborate calendar has been received from the Underfeed Stoker Company, Limited, of Toronto, the feature of which is splendid half-tone illustrations of the following public buildings in Canada in which "Jones" underfeed stokers have been installed: Foresters' Temple, King Edward Hotel and City Hall in Toronto; Grand Trunk Railway Building, Windsor Hotel, Place Vigar Station, Merchants' Bank Building, and Royal Victoria Hospital in Montreal; Kingston Penitentiary; Russel House, Ottawa, and Asylum at Orillia.

The New York Edison Company has recently placed a contract with Westinghouse, Church, Kerr & Company for another 6,500 h.p. Westinghouse vertical three cylinder compound engine of the same size and construction as the eight already in operation and being installed at their 39th Street Water Side Station. This contract includes an independent stream driven air and circulating pump condenser equipment and is the third order received from the New York Edison Company for these engines, the first covering eight units, the second two, and the third one, a total of eleven units, aggregating 71,000-H.P. normal, or 100,000-H.P. maximum capacity. The engines are direct connected to 4,000 K.W. revolving field generators, supplying high tension polyphase current to the various local sub-stations throughout Manhattan.

In the electrical world new inventions and creations are a matter of daily occurrence and many of these therefore pass with comparatively little notice. However, since the problem of electrical power transmission has become such an important factor, it is interesting to record the invention of "Type R," the new transformer which the Packard Electric Company, Limited, of St. Catharines, Ont., is now putting on the market. "Type R" is constructed along lines which makes the transformer much more compact and of much lighter weight while at the same time space for ventilation has been greatly increased by a novel adaption of the coils. "Type R" is so designed that much greater life is given to the coils and the insulation is made practically indestructible. In this way a higher electrical efficiency and closer regulation is attained. In placing "Type R" on the market the Packard Electric Company has this to say concerning its advantages: "In its actual performance "Type R" excels the claims made for any other transformer. We claim for it, first, a low difference of potential between layers and consequent greater safety; second, an almost indestructible insulation between the individual coils and between the coils and iron; third, the lowest temperature rise and maximum of radiation surface; fourth, the lowest core loss and the use of iron which will not show appreciable aging; fifth, small impedance and little magnetic leakage; sixth, a higher efficiency than any other regular line of transformers; seventh, the closest regulation. Backed by the Packard Electric Company these claims of excellence give "Type R" a right to the careful consideration of all transformer users. A preliminary bulletin descriptive of "Type R" will be sent on application to the Packard Electric Company, St. Catharines, Ont.

The ratepayers of Regina, N. W. T., are taking steps to install waterworks and sewerage systems and an electric light plant. It is estimated that the latter will cost $20,000.

SPARKS.

It is reported that a company is being formed in Smith's Falls, Ont., to manufacture electric transformers.

The Ottawa Street Railway Company have written to the city council offering to undertake a number of extensions to the system.

The Dominion Government is asking for tenders for the supply of shafting, etc., required for the transmission of power at the Artillery Workshops, Quebec.

The third electric street railway established in the Dominion was built in Yarmouth, N. S., in 1892. The enterprise was not a financial success, and the company has given official notice of the proposed discontinuance of the service.

The annual general meeting of the Shawinigan Water & Power Company was held in Montreal last month. Mr. R. W. Douglas, secretary of the company, was elected on the board of directors in lieu of Mr. William Farwell, of Sherbrooke. The directors left Montreal to make an inspection of the transmission line between that city and Shiwinigan.

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SPARKS.

Stowffville, Ont., is considering a scheme for an electric light plant for the village.

Mr. Charles E. Kilmer is installing an electric plant in the bobbin factory at Walkerton, Ont.

The Brome Lake Electric & Power Company, of Waterloo, Que., have decided to change from the flat rate to the meter system.

The Embro Radial Railway Company will apply to the Ontario Legislature for incorporation, to construct and operate radial railway lines extending from Embro, Ont.

The Berlin, Waterloo, Wellesley & Georgian Bay Railway Company will seek incorporation from parliament and the right to construct and operate an electric railway from Berlin to Waterloo, Collingwood, Owen Sound and Wiarton.

The Lethbridge Electric Company, Limited, of Lethbridge, N. W. T., has been incorporated.

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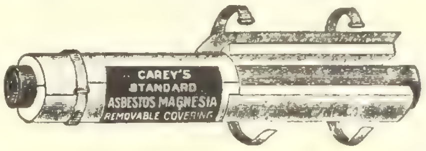

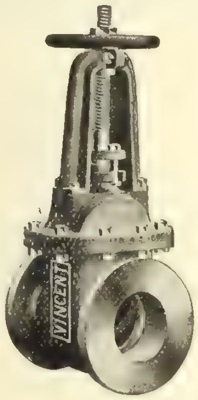

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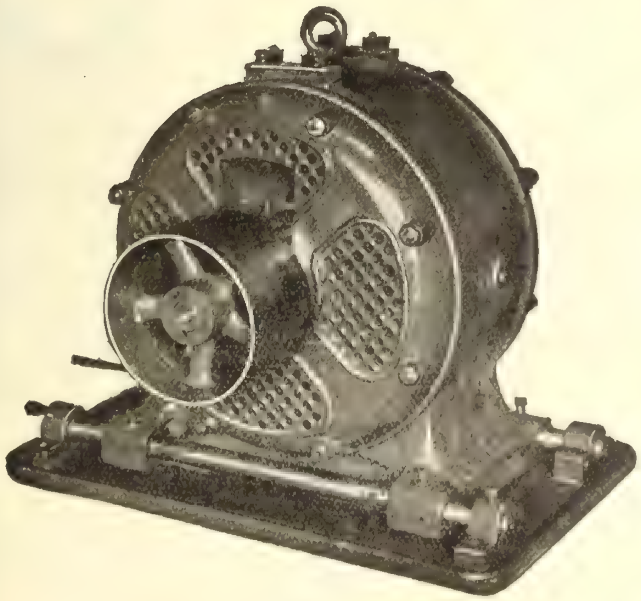

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SPARKS.

Mr. Fred Wade is looking into the question of establishing an electric light plant at Grand Falls, N. B. Difficulty has been found in securing a suitable water power.

The St. John Street Railway Company, of St. John, N. B., are about to erect a new building adjoining their power house, a portion of which will be elegantly fitted up as business offices.

A by-law to raise $40,000 to increase the electric light plant was carried by the ratepayers of Fort William, Ont., at the January election. Mr. G. G. King was elected Electric Railway and Light Commissioner.

The electric light plant at Tweed, Ont., owned by Messrs. Steinhoff & Gorden, of Wallaceburg, and managed by Mr. J. Pratt, was almost entirely destroyed by fire early in January. The loss is estimated at $4,500.

The steam turbine is recognized as the coming power producer, and Canada is determined not to be behind in this line. A small turbine (100 h. p.) is being built, which for simplicity of construction, mechanical efficiency, steam economy, small weight per horse-power, and other merits promises much to all interested in power development.

WELL PLEASED.

Mr. J. A. G. McGregor, of Lowell, Mass., in remitting his subscription to the ELECTRICAL NEWS, writes : "I am well pleased with the paper and am only too glad to renew my subscription."

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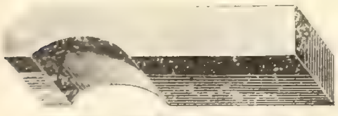

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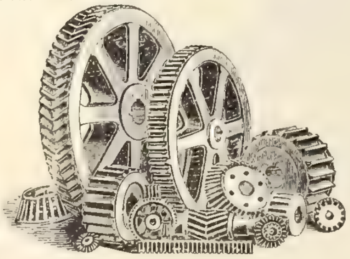

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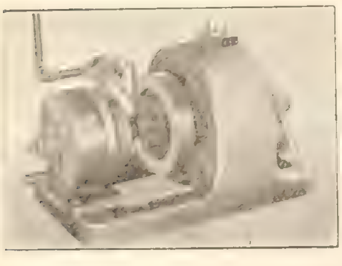

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SPARKS.

The Ontario Power Company are about to commence the erection of a large transformer station at Niagara Falls, Ont.

The contract for re-wiring the city hall at Hamilton has been awarded to B. B. Jones & Company, at the price of $485. The work is now in progress.

The earnings of the London Street Railway Company, London, Ont., for 1902 were $154,000, an increase of $13,000 over the previous year. The directors have been re-elected.

The net output of telephones by the American Bell Telephone Company during 1902 was 624,714, being the largest in the history of the company. The company has now in operation in the United States 3,150,320 telephones, and the number of subscribers is increasing at a tremendous rate, requiring an enormous increase of capital.

Detroit has had four competing telephone companies. The first company was heralded as a perfect gold mine for investors, but during the three years of its operations it proved a nuisance to the business community and finally was a disastrous failure financially. The three attempts following this were still-born. During the closing weeks of 1902 an effort was made to obtain an ordinance from the city council for a thirty year franchise for still another telephone company to take over the uncompleted plants of two of their predecessors, but Mayor Mayburry vetoed the measure on the grounds that it was not in the public interest.

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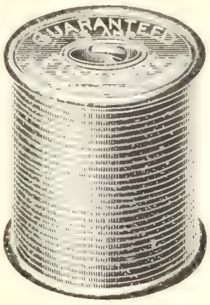

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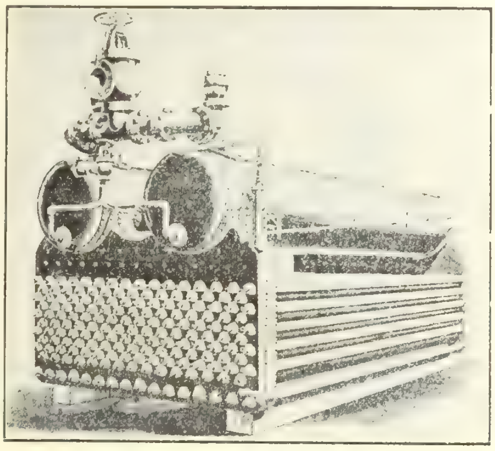

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SPARKS.

The total earnings of the Winnipeg Street Railway Company in 1902 amounted to $100,720.

Mr. C. M. Sherwood is installing an electric plant for lighting the village of Centreville, N. B.

On February 20th the ratepayers of Berlin, Ont., will vote on a by-law to raise $100,000 to purchase the electric light and gas plants.

The Mayor of Chatham, Ont., in his inaugural address to the city council, refers to the necessity of enlarging the electric light plant.

The ratepayers of Perth and Andover, N. B., are considering the advisability of incoporating the two villages for the purpose of installing an electric light plant. The idea is to develop a water power.

The town of Listowel, Ont., will apply for legislation at the forthcoming session of the Ontario Parliament to acquire the plant of the Listowel Gas and Electric Company. The proposal has already been ratified by the ratepayer.

The Montreal Locomotive & Machine Company is about to build extensive locomotive works in Montreal, the motive power of which will be entirely electricity. Mr. G. P. Brophy, of Ottawa, is the managing director of the company.

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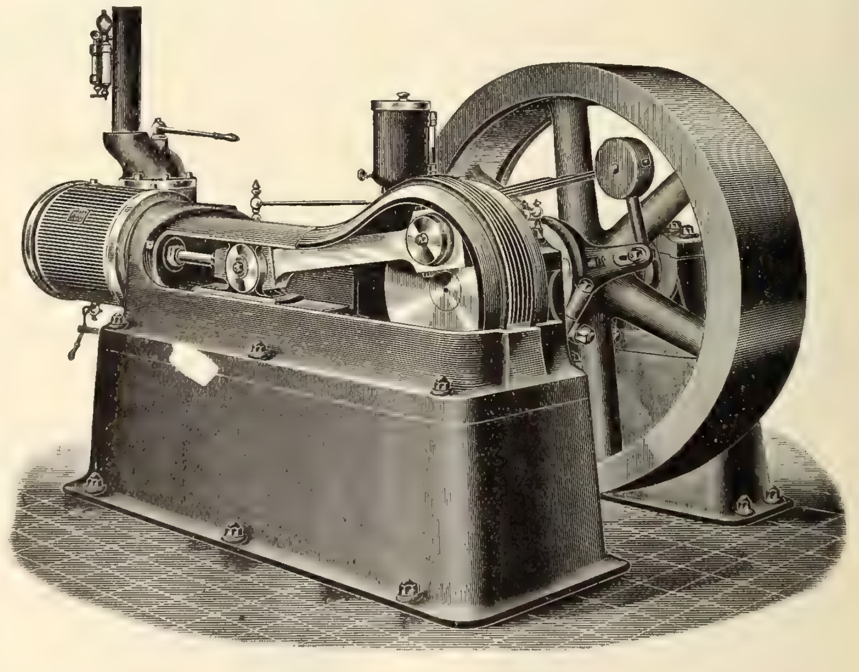

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PUBLICATIONS.

"Steam Power Plants," published by the McGraw Publishing Company, new York, is a book written to give information to owners or managers of manufacturing plants or buildings requiring power installations. It presents useful data in accessible and convenient form. The price is $2.00.

Mr. E. H. Sniffen read a valuable paper on "The Steam Turbine" before the American Street Railway Association at the recent Detroit convention. This paper has been published in booklet form by the Westinghouse Company, and all requests for a copy of same will receive attention at the nearest office of Westinghouse, Church, Kerr & Company.

"Electric Problems," by William L. Hooper, Professor of Electrical Engineering, Tufts College, Mass., and Roy T. Wells, Senior Fellow in Physics, Clark University, Wrocester, Mass. The work contains sets of problems typical of those met with in electrical laboratory and engineering practice, with very brief treatment of the methods of solution. It is intended to meet the need of a collection of numerical problems in the classes of colleges and technical schools. Ginn & Company, Boston, are the publishers, and the price, mailed free, is $1.35.

The citizens of Dalhousie, N. B., have appointed a committee to take steps to install an electric light plant. It is probable that arrangements will be made with the Dalhousie Lumber Company to undertake the work.

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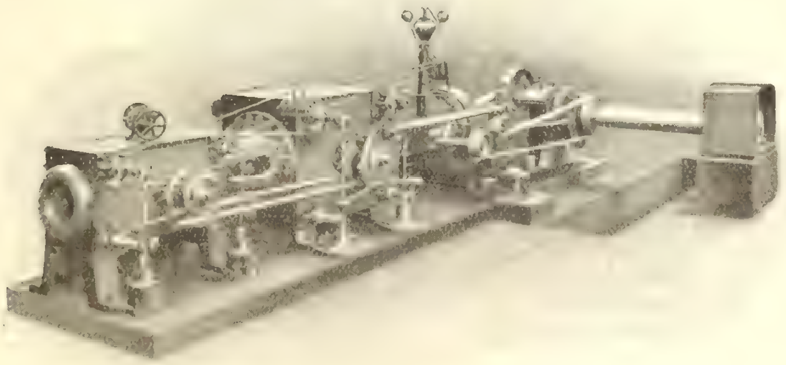

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SPARKS.

The Hill Electric Switch Company, of Montreal, have secured the contract for installing a switch-board in the new Montreal Board of Trade building in that city.

The business of the Northey Company, Limited, Toronto, manufacturers of gas and gasoline engines, power pumps, etc., has been absorbed by the Canada Foundry Company.

It is probable that the Grand Trunk Railway will appoint an inspector of telegraphs, who will have supervision of the whole telegraph system. It is hoped by this means to curtail the number of accidents.

The St. John Street Railway Company are about to award contracts for a large extension to their power house at St. John, N. B. It is the intention to install considerable new plant, the estimated cost of the proposed improvements being about $200,000.

The Dominion Power & Irrigation Company, Limited, has been formed to take over the water rights held by the Dominion Consolidated Mining Company and to develop the water-power at Okanagan Falls, B. C. Tenders are now being taken on the necessary turbines, dynamos and motors. R. H. Parkinson, C. E., of Fairview, B. C., is in charge of construction.

It is the intention of the Canada Foundry Company, which is controlled by the Canadian General Electric Company, to erect locomotive works in connection with their extensive plant in Toronto. When in Montreal recently Mr. Frederic Nicholls, general manager of the company, secured a contract for the supply of locomotives for the Canadian Pacific Railway.

The Hamilton Cataract, Power, Light & Traction Co., of Hamilton, Ont., has been incorporated, with a capital of $5,000,000. It is proposed to take over the business of the Hamilton Electric Light & Power Co., the provisional directors being the same as the directors of the original company. A statement given out by the company outline proposed extensions of the company's plant at DeCew Falls. Upon the opening of spring it is proposed also to extend the radial railway line from Burlington to Oakville.

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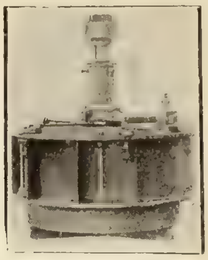

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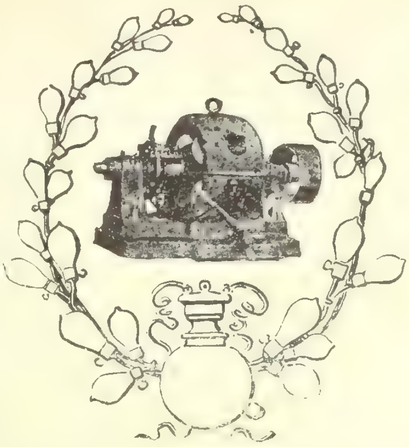

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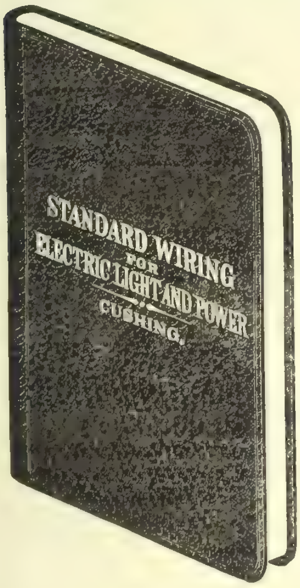

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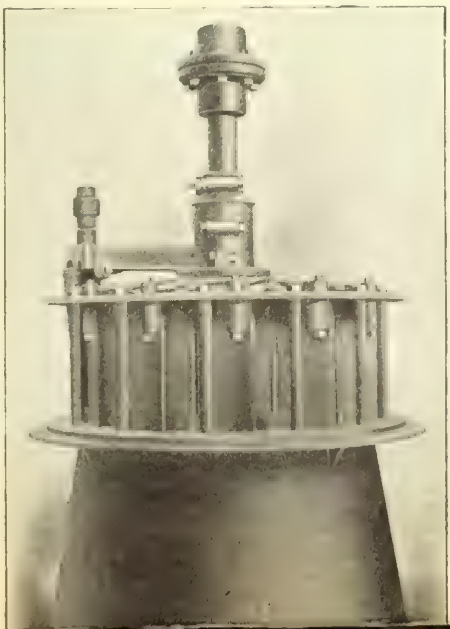

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High efficiency. Designed for any required speed or voltage. We contract for complete installations. We repair machines of any m[illegible] [illegible] quotes furnished on

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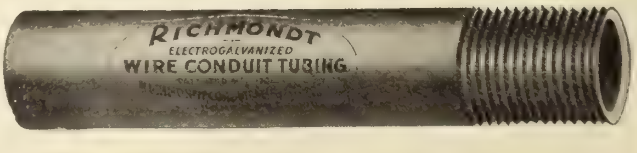

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TORONTO, CANADA, MARCH, 1903

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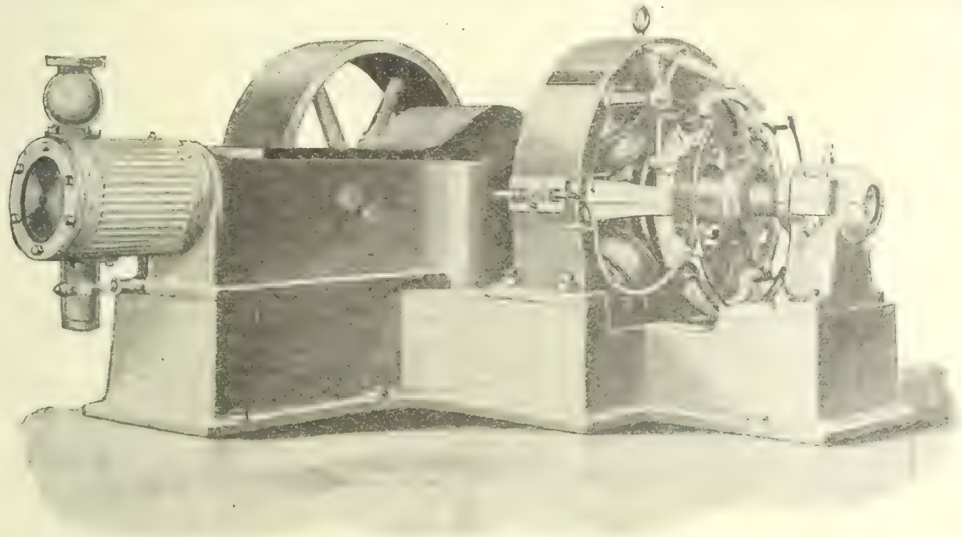

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Our designs are the latest.
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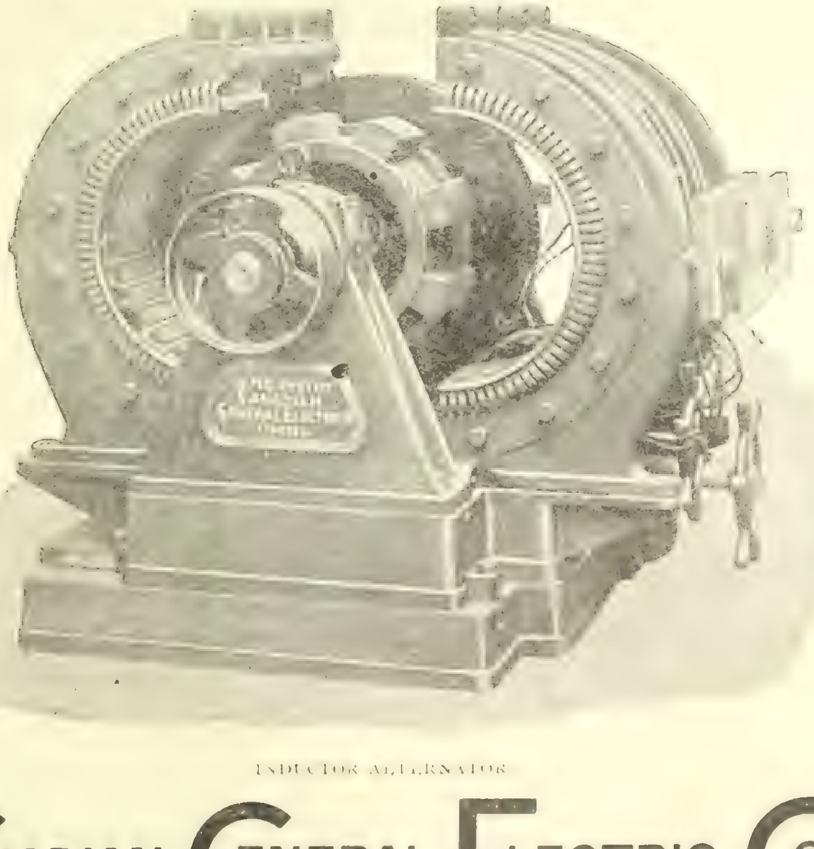

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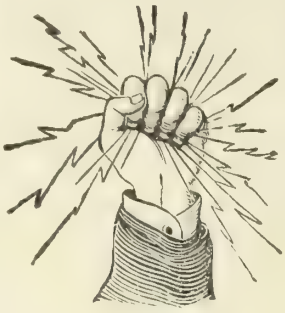

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Electric Light Line Wire
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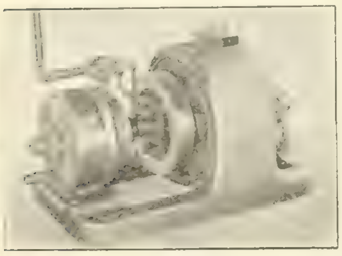
For your FACTORY, your SAWMILL, your STORE, your YACHTS and your STEAMERS, your COUNTRY-HOUSE or your HOTEL.

Direct Current Multipolar Generators



Direct-Connected to a throttle-governed Sleeper Engine.

The armatures will not heat.
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The control is automatic, there is no fluctuation of light.
Taken altogether they are the most efficient and the most perfectly automatic units ever offered.
Compact and light—space and weight minimized.

Write us for particulars, catalogs and prices.

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Office and works, corner Darling and Notre Dame Streets, Montreal

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Stuart-Howland Co.

Manufacture the most symmetrical, substantial and up-to-date line of

Street Railway Overhead and Pole Equipment

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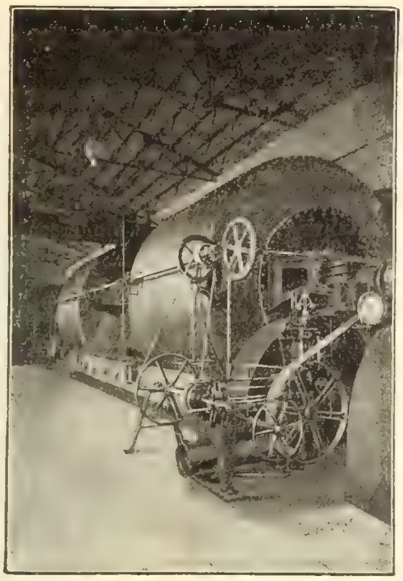

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Operating generators in power plant of Boston & Montana Consolidated Copper & Silver Mining Company, Great Falls, Montana.

Head 40 feet. — 2,800 Horse Power. — 300,000 Pounds.
The Heaviest Pair of Turbines Ever Built.

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The Goldie & McCulloch Co., Limited,

GALT, ONTARIO, CANADA

Recently received the following unsolicited testimonial, which speaks for itself :

TORONTO, Aug. 6th, 190[illegible].

THE GOLDIE & MCCULLOCH CO., GALT, ONT.

DEAR SIRS :—In our recent fire which, as you know, was a total wreck, and of which we are sending you a photo by this mail, we had two Goldie & McCulloch safes in which we kept all our books. They have come through the fire in remarkable shape and we feel that our praise for your safes cannot be great enough. This fire was an extremely hot one, the locality in which these safes were being surrounded by hay and grain as well as large quantities of packages, barrels and boxes. We might say that everything was burned to a crisp, heavy iron being twisted and melted into frightful shape. We had almost given up all hope of being able to get the books and documents from the safes in such a manner as to make them of any use to us, which we can assure you would have been a very serious matter. We were agreeably surprised, however, on reaching them. While we found the safes somewhat warped and bent on the outside, yet all our books and documents came out in such a manner that we can get everything from them all right. This without a doubt was an extremely hot fire, and the way in which they came through it leaves no room for question as to the manner in which they are made and the stuff they are made of.

Again congratulating you on the safes you turn out and trusting we will have the pleasure of purchasing from you when we again rebuild, as we know of none better, we are,
Yours truly,
P. McINTOSH & SON.

CATALOGUE AND ANY OTHER INFORMATION ON APPLICATION.

We Make

WHEELOCK ENGINES, IDEAL ENGINES, GAS AND GASOLINE ENGINES, BOILERS, PUMPS, WATER WHEELS, OATMEAL MILL MACHINERY, FLOUR MILL MACHINERY, WOLF GYRATORS, WOOD-WORKING MACHINERY, SHINGLE MACHINERY, HEADING AND STAVE MACHINERY, WOOD RIM SPLIT PULLEYS, IRON PULLEYS, SHAFTING, HANGERS, GEARING, COUPLINGS, FRICTION CLUTCH COUPLINGS, FRICTION CLUTCH PULLEYS, SAFES, VAULTS AND VAULT DOORS.

SPARKS.

The Coaticook Electric Light Company, of Coaticook, Que., have offered to dispose of their plant to the town for $46,000.

The by-law to take $25,000 of stock in the Huron, Bruce and Grey Electric Railway was defeated in Colborne Township by four votes.

The Lethbridge Waterworks and Electric Light Company, Lethbridge, N. W. T., has changed its name to The Lethbridge Electric Company, Limited.

Mr. John Peck, chief inspector of boilers for British Columbia, says there are 400 duly qualified engineers in the province, and 300 applications from engineers to be inspected yet.

Negotiations are under way for the purchase by the city of Sherbrooke, Que., of the electric light and gas plants of the Sherbrooke Light & Power Company. The company values the property at $270,000.

Mr. Frederic Nicholls, manager of the Canadian General Electric Company, is interested in the Canadian Shipbuilding Company, which purposes constructing works on the Niagara river near Fort Erie.

Mr. E. R. Wood, of Toronto, a director of the Mexican Light & Power Company, stated a fortnight ago that no orders for machinery had yet been placed. The plans for the proposed development are being prepared by Mr. Hugh L. Cooper, of New York.

The electric plant at the Granby smelter at Grand Forks, B. C., is to be considerably increased. An additional transformer, with a capacity equivalent to 1,200 horse power, will be installed, thus bringing the transformer capacity up to 1,700 horse power.

Mr. W. H. Breithaupt, president of the Berlin and Bridgeport Railway Company, announces that his company has under contemplation the extension of the company's Bridgeport line up north through Bloomingdale, Conestogo, Winterbourne and possibly to Elora and Fergus.

Messrs. Fogarty Bros., of Montreal, have secured contracts for electric light and power installations for the DeLaval Manufacturing Company, United Shoe Machinery Company, and R. J. Tooke's new factory in Montreal, also for electric light installation for Francistown, Que.

The Winnipeg Electric Company is the name of a new concern which has commenced business and opened an office at Room 46 Canada Life block, Winnipeg. The company is composed of Messrs. Leonard E. Dye, late electrical foreman for the E.S. Harrison Co.; Chas. Goodwin, formerly telegraph inspector for the Canadian Pacific Railway; and Chas. P. Anderson, formerly accountant for the E.S. Harrison Co.

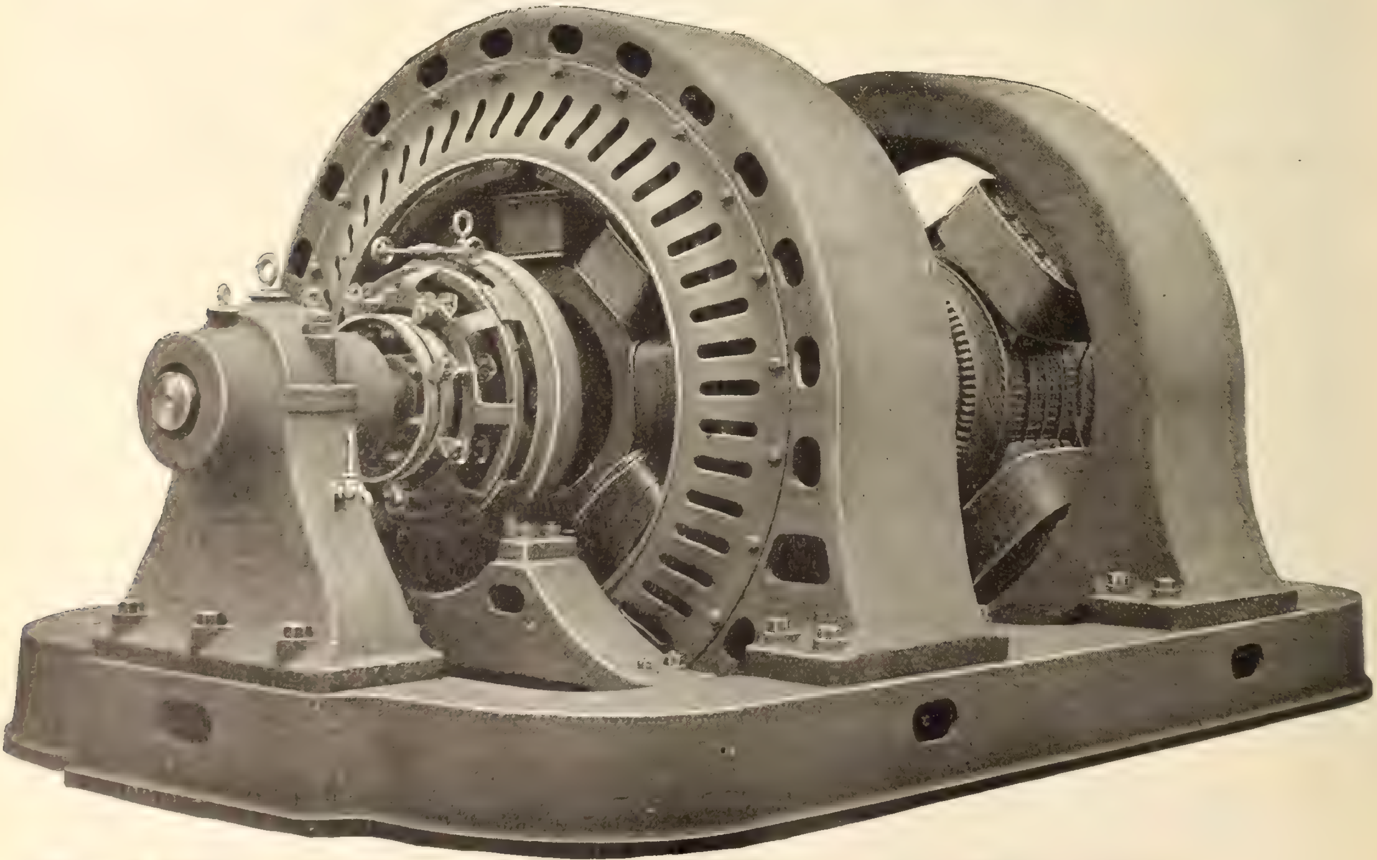
A charter has been granted to the Electric Development Company of Ontario, Limited, with a capital of $6,000,000. The head office will be in Toronto and the provisional directors are W. H. Templeton, Chas. V. Bennett, J. W. Rose, Alex. McKenzie, E. G. Long, all of Toronto. The names of the capitalists behind the company are not disclosed. Permission is given to develop power of all kinds and to operate telegraph and telephone systems in connection with the works.

Reconstruction faces the English company which owns a seventh interest in the electric power plant at Cascade, B. C. The Dominion Mining, Development & Agency Company, as it is called, will be replaced by the Dominion Trust, Limited, with a capital of $375,000. At a recent meeting in London the chairman pointed out that a 10 per cent. dividend could be expected soon from the stock in the Kettle River Company owning the Cascade power plant. That company has spent nearly $500,000 in harnessing 6,000 to 7,000 horse power for generating electric power to operate the Boundary mines.

The Cuychoga (Ind.) Telephone Company, of Cleveland, having made application to the City Council for the right to increase its rates and been refused, now propose to go ahead with the increase without permission of the Civic Government. The officials of the company stated before the Council that they must get higher rates or go out of business. The proposed increase is for residence $36 to $40, and business $48 to $60 per annum. These rates are interesting to Canadian telephone users, who have been getting service at less rates than the above without the expense and nuisance of competition.

Dick, Kerr & Company

LIMITED



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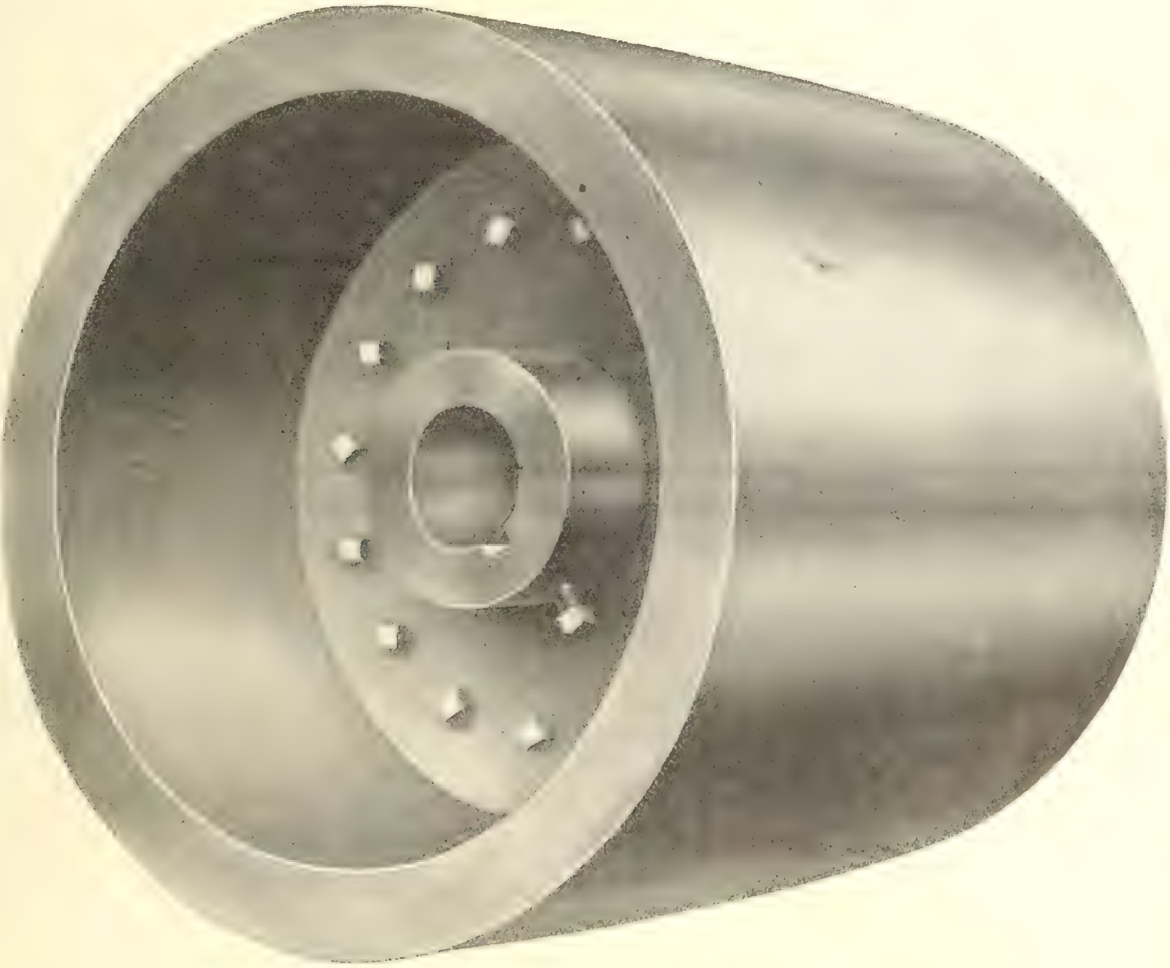

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SPECIFY XYLOTITE PULLEYS ON ALL APPARATUS

WE MAKE ALL SIZES. NONE TOO LARGE OR NONE TOO SMALL.

THE XYLOTITE MFG. CO.
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THE MIDLAND ARBITRATION.

PICTON, ONT., March 4th.

Editor ELECTRICAL NEWS

DEAR SIR,—I saw in your February number a small article on Midland Electric Light Arbitration, and must confess that I was surprised at the small amount of $9,636 being awarded to Mr. Playfair for his plant. Now there must be something wrong either with the arbitrators or with the plant. If this plant is in fairly good shape it should be worth at the very least $15,000 to the corporation of Midland at the present time. Perhaps it was argued that the boilers and engines had been in use for sometime and were worn out. In the Picton Electric Light and Water Works plants a slow speed Wheelock engine 16"x38" has been in constant use for 13 years and has never had one cent of repairs except the slide valves planed off occasionally as needed. We have two boilers, 14x5, which have been in use 14 years with a steam pressure of 80 lbs., and we recently had them tested to 100 lbs. and they showed no signs of leaks whatever.

I am merely stating these facts to give you some idea of the life of boilers and engines if properly cared for. The electric apparatus you state is new or nearly so. If that is the case, there can be very little depreciation on that part of the plant. I have not gone into the matter very fully, but from a rough estimate it would cost the corporation of Midland about $30,000 to install such a plant as Mr. Playfair's, and surely his plant is worth fifty cents on the dollar.

Yours truly,
T. O. CRANDALL,
Superintendent Picton Electric Light and Waterworks.

PERSONALS.

Mr. Edward Blair, who for some time has held a responsible position in connection with the Quebec Electric Street Railway, has been appointed assistant superintendent of the Montreal Street Railway.

Mr. Frank Priestland, formerly with the Niagara Falls Power Co., has been appointed manager of the Smith's Falls Electric Power Co., to succeed Mr. John Davidson, who will leave shortly for British Columbia.

Mr. Merrill Van G. Smith has been appointed Associate Professor of Mechanical Engineering by the Board of Trustees of the Clarkson School of Technology, of Potsdam, N. Y., to fill the chair made vacant by the resignation of Prof. Robinson last November.

Many Canadians will regret to learn that Mr. Edward Slade, manager of the Jacques Cartier Water Power Company, of Quebec, has tendered his resignation, to enter the employ of William F. Beal & Company, real estate and mortgage brokers of Boston, as appraiser and construction engineer. Mr. Slade has a wide circle of business and social acquaintances who will wish him the success which he well deserves in his new field.

At the sixth annual meeting of the British Columbia Electric Railway Company, held in London, Eng., on January 21, the president referred to the splendid services which had been rendered to the company by the general manager, Mr. J. M. Buntzen, and concluded : "I think it would be difficult to find anyone who would give such splendid attention to the company's business, and of course very much must depend upon what he does."

After twenty-one years' service with the Montreal Street Railway Company, Mr. M. J. Kennedy, general superintendent, has tendered his resignation, for the purpose of engaging in business on his own account. Mr. Kennedy began his street railway career as a conductor on the horse-car line in Montreal twenty-six years ago. In 1886 he accepted a position with the Twin City Railway Company, of Minneapolis, returning to the Montreal Company in 1891. In his Montreal career he passed through the evolution of the service and filled every position from a collector of fares to that of general superintendent, to which position he was appointed when Mr. McDonald resigned three years ago to go to Paris.

TOO INTERESTING TO DO WITHOUT.

L. C. McLeay, Watford, Ont. : "Have been supplied with some copies of the ELECTRICAL NEWS, and find it too interesting to do without. I purpose extending my electric light plant to double its present capacity and find the need of your valuable journal to keep me to the front. Enclosed find money order covering subscription."

The real test is actual operation. When all has been said, the fact remains that a poor transformer cannot give a service free from burn-outs or other troubles.

Quebec-Jacques Cartier Electric Company.

QUEBEC, CAN., February 26th, 1903.

PITTSBURGH TRANSFORMER COMPANY,
PITTSBURGH, PA.

GENTLEMEN,—Replying to your enquiry of the 11th, we may say that we have somewhere in the neighborhood of 200 K.W. in Pittsburgh power transformers and about 900 K.W. in Pittsburgh lighting transformers, ranging from 1 K.W. to 15 K.W. units. On an average these transformers have been in use for three years. So far we have had four cases of burn-outs and there is only one case in which the cause could not be traced to either lightning or overload.

We take pleasure in saying that we consider the transformers have given us entire satisfaction up to date, and the careful test which each transformer has been subjected to before putting into service shows that the transformers are of a superior quality.

Yours very truly,
QUEBEC-JACQUES CARTIER ELECTRIC CO.
Edward Slade, General Manager.

The R. E. T. Pringle Company, Limited.
SALES AGENTS **172 Dalhousie Street, Montreal.**

Pittsburgh Transformers.

We repair [illegible] furnished on

Westinghouse Transformers

Spread Coils are found only in Westinghouse Transformers

Their use in Type N. and O. D. Transformers secures low and uniform temperature.

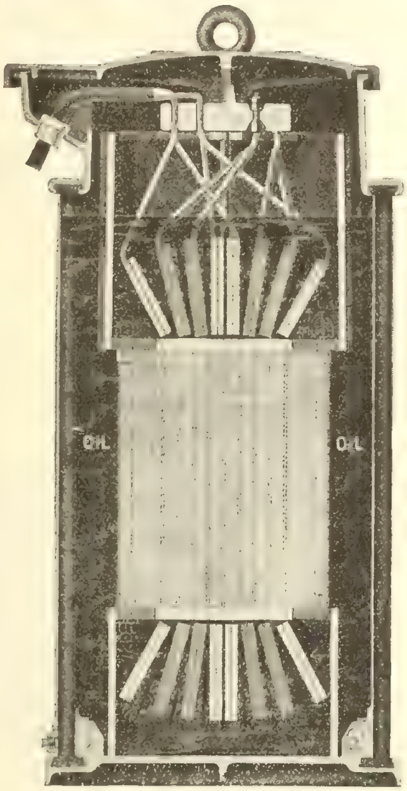
Low Temperature eliminates the aging of iron.

Low Temperature prevents the oxidization and deterioration of insultation.

Low Temperature reduces the resistance of the copper with consequent improvement in efficency and regulation.

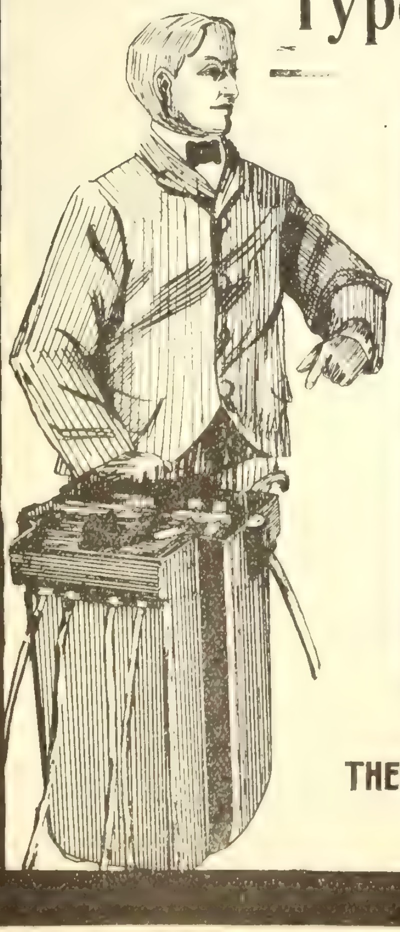
Low Temperature gives overload capacity, permitting the use of a small transformer for large intermittent loads.

Write for Transformer Booklet



Cross Section of Transformer

AHEARN & SOPER, Limited
Ottawa, Canada



Type "R" Packard Transformer

Durability is one of the essential features to economical Transformer operation, and as the durability of any Transformer depends upon its insulation — type "R" Packard Transformer, owing to its practically indistructible insulation, is most economical.

Combined with its long life, it has a very high electrical efficiency and close regulation, and we stand ready to demonstrate to any user that type "R" is the most economical Transformer ever made.

MADE IN CANADA BY
THE PACKARD ELECTRIC CO. LIMITED.
ST. CATHARINES, ONT.

EASTERN OFFICES
1/2 STREET RAILWAY BLDG.
MONTREAL

BEST SELECTED

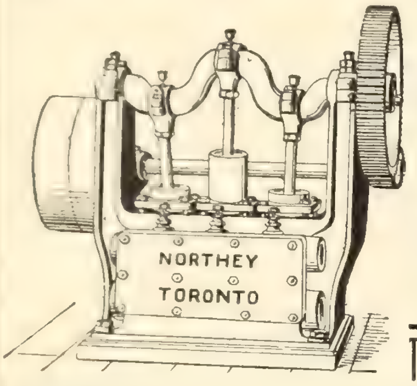
Sulphate of Copper

FOR ELECTRICAL PURPOSES.

WATSON JACK & COMPANY

MONTREAL

THE NORTHEY TRIPLEX POWER PUMP



This pump excels in high class materials and workmanship. A practically constant delivery is assured by the three cranks being placed 120 degrees apart. The pump can be operated conveniently by water power—by belt from engine or by electricity.

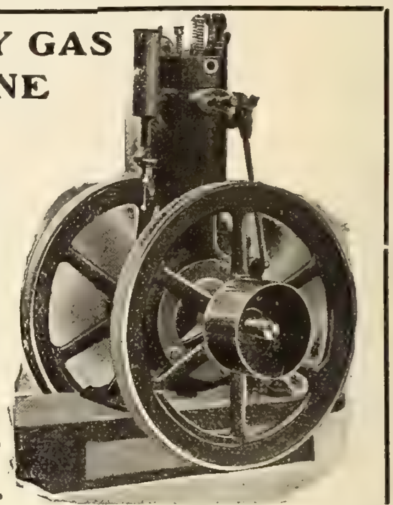
We manufacture pumps of every description—for all purposes. Our pumps are standard in Canada for excellent service.

Write for Catalogues.

The NORTHEY GAS AND GASOLINE ENGINE

The Northey Gasoline Engine offers the best proposition in the market for cheap, easily handled power. The Engine runs with practically no attention—any boy can manage it—running expenses very light. Ready for work on the minute. Suitable for running independent electric light plants—pumping and elevator plants, etc. This cut illustrates the ½ H. P. size—the only vertical style built; all other sizes are horizontal.

Write for Booklet.



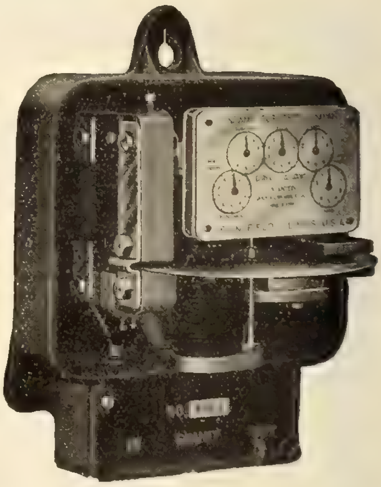
THE NORTHEY CO., LIMITED, 970 King Street Subway TORONTO.

NEW GUTTMANN WATT METER

FOR ALTERNATING CURRENTS

IN SHORT

- The New Meter is of the sealed type.
- Is correct on all loads from two per cent. of its capacity to fifty per cent. overload.
- Internal losses are practically nothing.
- Accuracy maintained.
- Simplicity in design.
- Firmly constructed.
- Dust, insect, moisture and water proof.
- Extremely light weight (10 lbs.)
- Pleasing in appearance.
- Reads directly in watt hours.
- Easily installed.
- No complicated parts.
- No friction.



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**708 and 710 Craig Street
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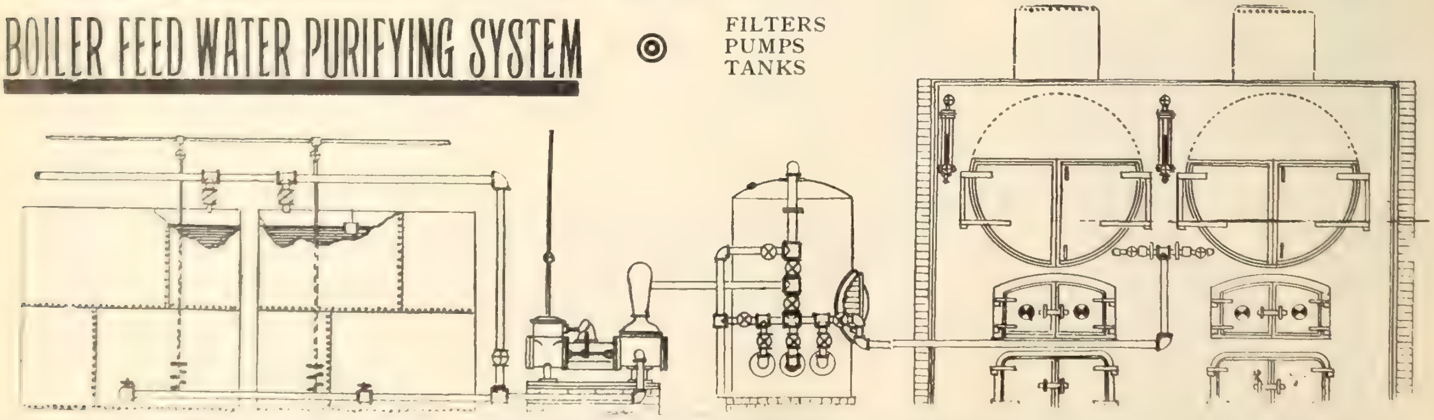
BOILER FEED WATER PURIFYING SYSTEM

◎ FILTERS
PUMPS
TANKS



THE JOHN McDOUGALL CALEDONIAN IRON WORKS, LIMITED, - - Montreal, Que.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

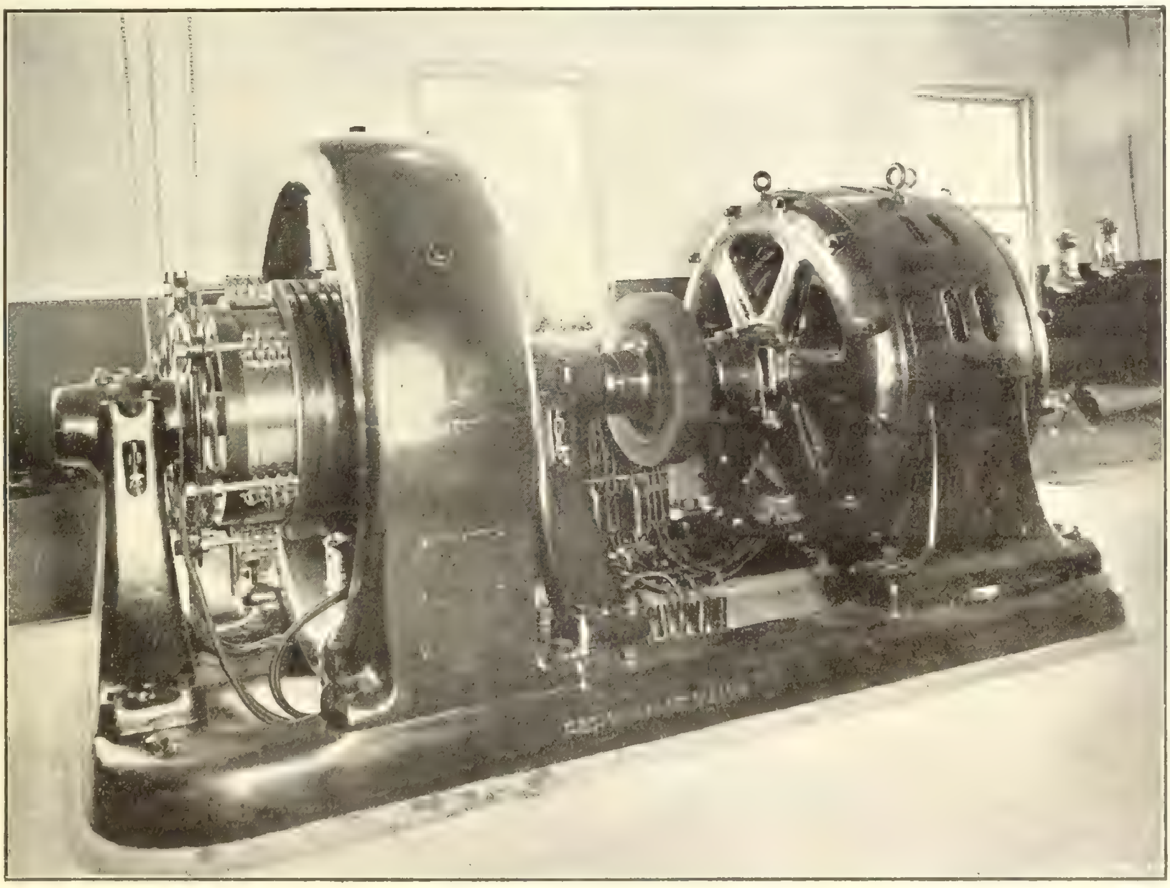
VOL. XIII. MARCH, 1903 No. 3.

INSTALLATION OF THE OTTAWA AND HULL POWER AND MANUFACTURING COMPANY.

In the spring of 1901 a Dominion charter was granted to the Ottawa and Hull Power & Manufacturing Company to develop power at a certain point on the Ottawa river at Chaudiere Falls. The promoters of the company included Messrs. W. C. Edwards, M.P., Alex. Fraser, H. K. Egan, Hiram Robinson and R. Blackburn. Work in connection with the development was commenced in the summer of the same year and has recently been carried to completion. The power house is a substantial structure, of fireproof construction, practically all steel and concrete. While the plant does not embody many features which differ materially from standard engineering practice of to-day, careful attention has been given to its equipment and arrangement with a view to economical operation.

The Ottawa and Hull Power Company is solely a producing corporation, and from this fact is somewhat unique. The total power generated is transmitted to a sub-station of the Consumers' Electric Company, by whom it is distributed to customers.

There are at present installed in the power house two 1,500 k.w., 60 cycle, 2,300 volt, two-phase revolving field generators, direct connected to water wheels running at 138 r.p.m., and two 112 k.w., 125 volt, compound wound, direct current generators to be used as exciters. These latter are sufficient for exciting the total number of alternators which will ultimately be installed, namely, five.. They are direct connected to wheels running at 320 r.p.m. Details of the turbine installation are given further on.



MOTOR-GENERATOR SET IN SUB-STATION OF CONSUMERS' ELECTRIC COMPANY, OTTAWA.

All the electrical apparatus was supplied by the Canadian General Electric Company. The generators, one of which is shown on the following page, are guaranteed to carry a 50 per cent. overload for two hours.

The switchboard, rear views of which are shown, consists of the usual arrangement of generator, exciter and feeder panels, equipped with automatic switches, wattmeters, ammeters, etc. The field rheostats are located below the main gallery, as are also part of the switches, current transformers, etc. This arrangement provides ample room to handle all parts with freedom and effectually prevents any possibility of an arc should one be accidentally established in one part of the board communicating to any of the adjacent equipment. There are two sets of busbars so arranged with suitable switches that any circuit can be thrown onto one set or the other. The generators can be similarly connected, which allows the light and power circuits to be kept entirely separate if such is desired.

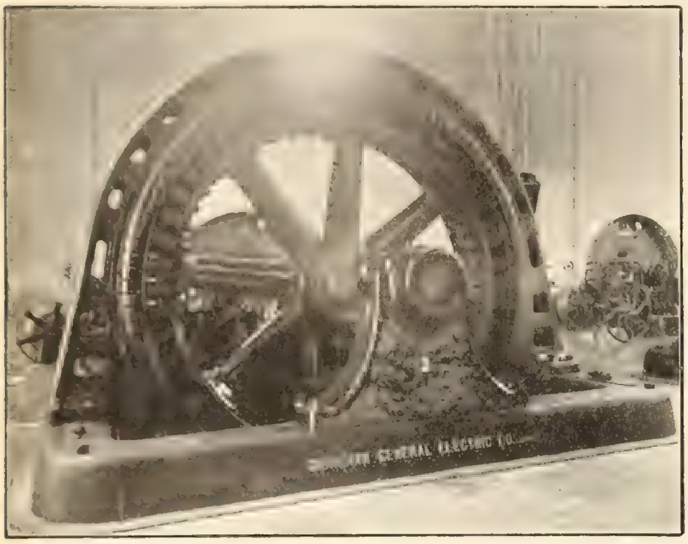


Fig. 2.—One of the 1500 k. w. Alternators in Power House of Ottawa & Hull Power Company.

As stated above, the current is transmitted at 2,300 volts to a station of the Consumers' Electric Company, the installation in which consists of a 200 horse power motor generator set, composed of a 200 h.p. 2,000 volt induction motor direct connected to a 150 k. w. 500 volt direct current generator, as shown in Fig. 1. This set supplies power to various motors throughout the city. There is also a constant current transformer for controlling an alternating current series arc light circuit which illuminates the beautiful drive of the Ottawa Improvement Commission. All of the foregoing machinery was manufactured and installed by the Canadian General Electric Company. The switchboard which controls the alternating lighting and power circuits was furnished by the R. E. T. Rringle Company,of Montreal. All the wiring is done in lead covered cables, which are laid in ducts and tunnels underneath the floor, and thence out through the wire tower to the overhead lines. This makes an extremely safe and neat arrangement, the appearance of the whole building, both inside and out, being very pleasing. In addition to the dynamo room proper, the station also contains offices, store and testing rooms.

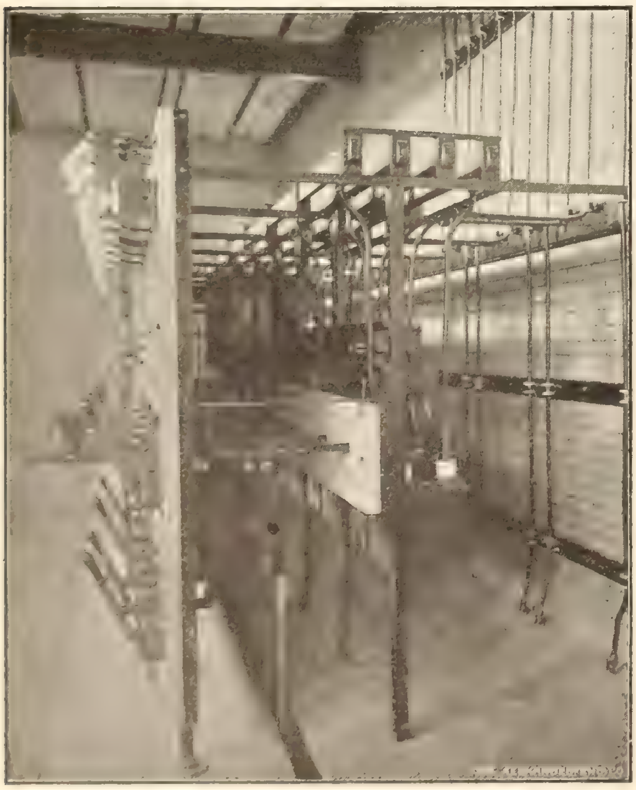


Fig. 3.—Switchboard on Gallery, with Upper Set of Switches and Busbars.

Reverting to the turbine installation in the power house of the Ottawa and Hull Power Company, the average head is 27 feet. The turbines for each generating unit are four in number, connected tandem, and were built by the Dayton Globe Iron Works Company, of Dayton, Ohio, being their latest improved cylinder, gate draw-rod type. They are mounted on two cast-iron draft chests, with draft tubes 9 feet in diameter (Fig. 5). The wheels proper are of the New American type, made in one continuous casting, 51 inches in diameter, and when tested at the Holyoke testing flume gave an efficiency of 86.71 per cent. at full gate. This wheel is one of the most efficient ever tested in the Holyoke flume. The shafts are made of steel and were forged by the Bethelem Steel Company. They are in two pieces each, with intermediate coupling flanges forged on. They are 5 7/16 inches in diameter at the remote ends, increasing in size to 10½ inches in diametor at the driving ends. The gate is of the well-known cylinder draw rod type and has several features not usually found in this class of gate.

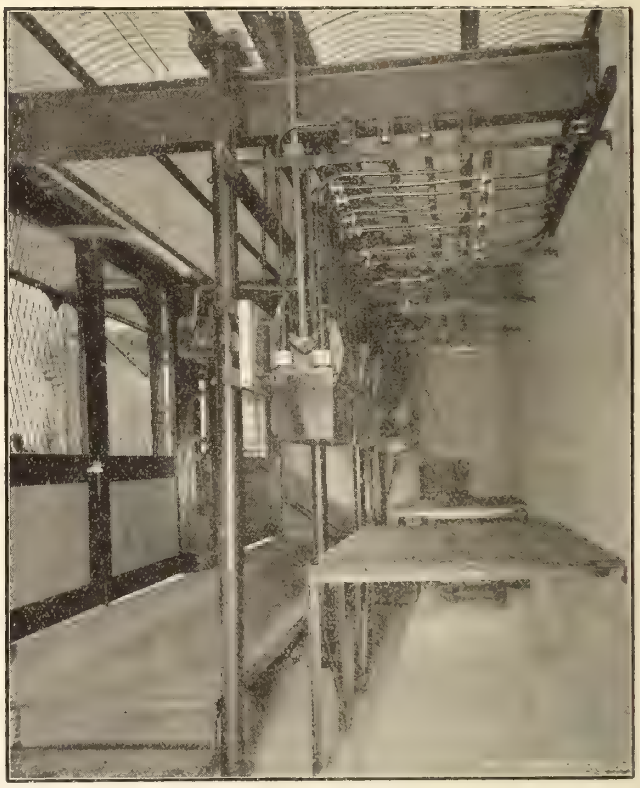


Fig. 4. — Lower Set of Busbars and Switches on Main Floor Immediately Below Fig. 3.

The gate proper slides on ways similar to those on a steam engine. On these ways or guides are adjustable gibs, which can be operated by bronze set-screws, thus taking up the wear and keeping the gate from touching or rubbing the inlet chutes on the bottom. The gate rods are fastened to the gates in the center of these guides or ways, bringing the line of force and that of resistance on the same plane, thus obviating the tendency to tip and bind which is most objectionable in ordinary cylinder gates when operating horizontally. This method of operating gates has proved so successful that the manufacturers have patented it.

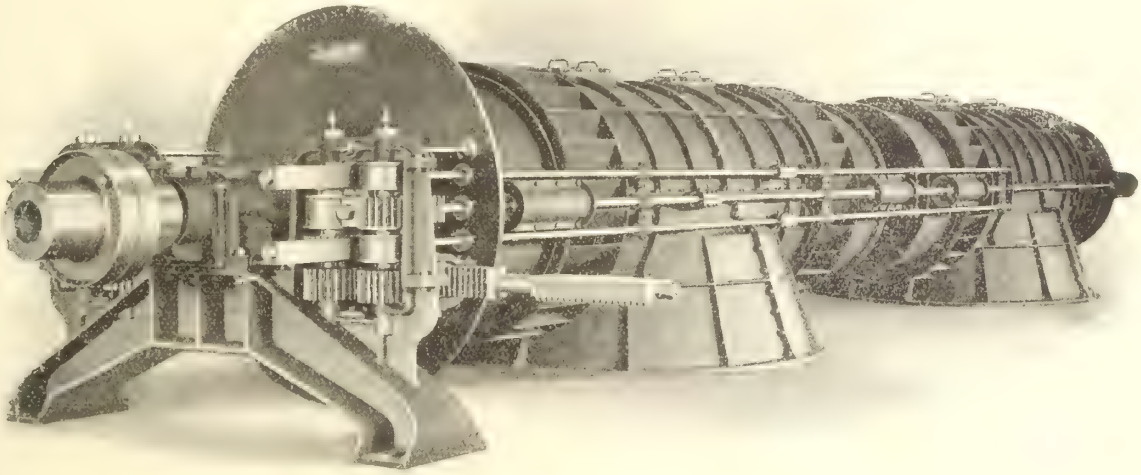


Fig. 5. -Tandem Connected Turbines.

Another feature of this device is, that all gearing races, etc., are outside of the flume, away from the water, and accessible at all times. This entire mechanism is mounted on the main bridge-tree, as shown in Fig. 5. It consists of two vertical shafts on each side of the bridge-tree, on which are placed cut pinions to move the cut racks on the gate rods, the rods passing through the stuffing boxes in the flume head. In order to bring the line of action in the centre of the gate bearings, three draw-rods are used. The upper and lower rods act in conjunction with one another and move the gate of the second and fourth wheels through yokes and hollow tubes. The gate rod on the wheel, No. 2, is a hollow brass tube so as to allow the centre gate-rod which operates the gates on wheels No. 1 and 3 to pass through for a connection to gate No. 3. The two lower pinions on the vertical shafts on the bridge-tree are connected to the transverse or operating rack by an intermediate gear (not visible in the cut), thus causing all the gate rods on both sides of the wheels to move in unison. The governor and hand-operating device is connected to the transverse racks by a pinion working into the racks shown on the end.

The gears and racks are supported by a cast-iron frame of the bridge-tree and are also stayed to the flume head by large stay bolts, thus giving the entire structure great rigidity and maintaining a compact design, the principal elements of which have been patented. All the bearings in the water are of lignum vitae and are adjustable by bronze set-screws for taking up the wear. The thrust is taken care of by lignum vitae thrust bearings on the rear end of the shaft. The governors are of the Woodward compensating type and were built especially for this installation. The turbines for the exciter units are of the cylinder draw-rod type similar to the generating units. There are two sets of two wheels each of the New American type, 22 inches in diameter, mounted on sheet steel draft chests, the whole mounted on steel I-beam foundations, built in the concrete. The gate operating mechanism is the same in principle as that of the large units, but not so complicated, as there are only two wheels in each unit to control. The governors on these units are the Woodward compensating type.

Fig. 6 is a rear view of the exciter unit showing the connecting yoke for the gate-rods. This view also shows the position of all the gate-rods on the centre plane of the shaft.

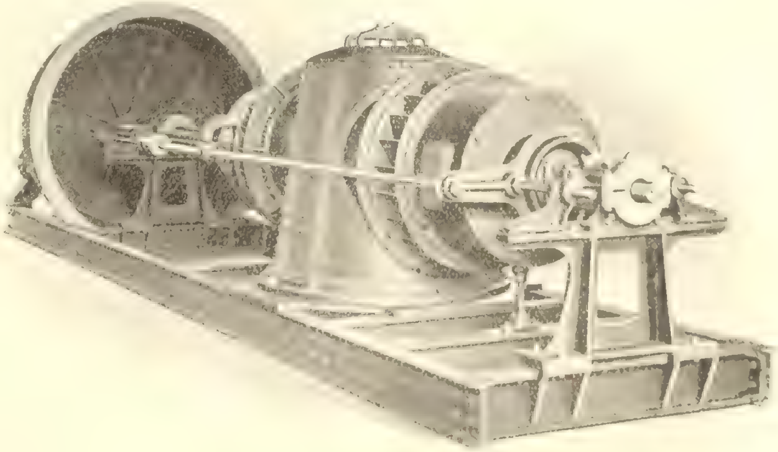


Fig. 6. Exciter Turbine.

This installation was made under the supervision of Mr. Wm. Kennedy, Jr., hydraulic and mechanical engineer, of Montreal, Que.

Mr. Gordon Logan, chief accountant for the West Kootenay Power & Light Company, of Rossland, B.C., recently spent a short time in the east on business.

THE CANADIAN GENERAL ELECTRIC COMPANY.

The statement presented at the recent annual meeting of the Canadian General Electric Company, held at the head office in Toronto, was of a very satisfactory character. It showed that the profits for the year 1902 were $436,863.10, out of which two half-yearly dividends amounting to $213,739.22 were paid. Of the balance $120,081.78 was written off for depreciation, $100,000 transferred to reserve, and $3,042.10 added to credit of profit and loss account, which now stands at $80,722.37. Balance at credit of profit and loss December 31, 1901, was $612,028.94. To the $100,000 carried to the reserve fund from manufacturing profits the sum of $322,000, being premium of new share capital, has been added, making a total addition to the reserve fund for the year of $422,000. The reserve fund is now $787,000, plus $100,000 at contingent account, and $87,722.37 balance at credit of profit and loss, making the total surplus $967,722.37. As the company's permanent investment in the Canada Foundry Company's plant is $858,322, it will be seen, adds the report, that the surplus is more than sufficient to entirely cover the cost of this asset.

Although dividends have been paid on the new capital stock issued last year, this new capital has not hitherto been productive, as it has been invested in the Canada Foundry Company's business, which has already reached large proportions, but upon which no profit has been taken into account, although a small profit has been earned. In order to provide manufacturing facilities commensurate with the growth of the company's business, the directors have decided to again provide for extensive additions to the company's plant and equipment, and plans are being prepared for this purpose. An agreement has been entered into for the purchase of the Northey Manufacturing Company, of Toronto, manufacturers of steam pumps and hydraulic machinery.

During the year the company has also acquired the Canadian patents of the Curtis steam turbine for both land and marine uses. The steam turbine will probably revolutionize present methods of producing steam power, and many advantages are expected from this acquisition. The United States patents for this invention have been purchased by the General Electric Company, of Schenectady, N.Y.

Arrangements are being made with the Canadian Shipbuilding Company, whose works are to be located on the Niagara River, near the International Bridge at Fort Erie, which will provide for the manufacture by the Canada Foundry Company of the marine engines, boilers, and other machinery required by the shipbuilding company.

The Brantford Street Railway, which was previously owned and operated by the company, has been sold, the company taking in payment therefore first mortgage bonds on the property for $120,000.

The Canadian General Electric Company have had plans prepared for several new buildings to be added to their extensive works at Peterboro, Ont. One building will be 450 x 80 feet, to be used as a stores and shipping depot; another will be a manufacturing building 235 x 80 feet, and a third will be an addition to the new building erected last year. The buildings will be of brick and steel construction.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, March 11th, 1903.

We have the professional labor agitator from Toronto with us once again. This can hardly be a case of Toronto's loss being Montreal's gain!

How long is the electrical trade to be yet annoyed by 52 volt secondary service in Montreal? Surely it is time the small remaining residue of such customers were changed (like many) to 104. Then with both competing companies with a voltage and frequency practical similar, there would be some confidence in selling fans, heating devices and the like.

Claim is made that Prof. Rutherford, of McGill College, was the real inventor of the "magnetic detector" used by Marconi in place of the "coherer" in trans-Atlantic wireless telegraphy, the reason of this preference being given—that the detector is more sensitive than the coherer. Prof. Rutherford is a man amongst many who unfortunately do not imitate his broadmindedness. He does not believe in patenting any device that is likely to be of benefit to the public as a whole. Would that there were more inventors of the same stamp.

The Nernst lamp is making its appearance by degrees in Montreal, the single glower 110 volt type being by far in the majority over other types; this probably owing to lack of 220 v. a. c. current supply. The 220 lamps show up well and so do the 110, except that the glowers for the 110 seem to be a "bit more tender" than those for 220.

McGill University have entered their protest against Marconi being allowed to operate a wireless station from the summit of Mount Royal. The "kick," however, simmers down to one of a rather selfish nature. It is made under two heads: First, that such will interfere with their laboratory instruments; second, that Marconi currents will be conducive to electrical fires in Montreal. The first goes without question, but what of it? McGill will have to devise means to shield their instruments.

In Montreal Street Railway vs. Bell Telephone Company, it was decided that the use of the earth was common property, and it remained for the Bell Company to devise means to properly work its instruments. Surely the air is no less common property. The second point drew a number of insurance men up to McGill laboratories to see just how such fires could occur. The deductions, however, were of such a purely theoretical nature as to prove nothing of practical value to any electrical engineer. The only point of real value, and that was overlooked, was the desirability of having such on a public park? Would it not cause requests from factories also for permission to build on that site?

The late strike of the Montreal Street Railway employees was one of the silliest that has occurred. First, although the talk of a strike occurring and definite hour for same was public property for three days previous, yet when it did occur the management expressed surprise and were caught in a blissful state of unpreparedness. Second, from the striker's end the strike was totally unnecessary and there was not a single item conceded that would not have been secured through a signed petition or "round robin." The only good (if it can be called) brought forth by the strike was the opportunity given to some of our aldermen to show, by word of mouth, their David & Jonathan-like love for the working man (pro-tempo!) The thanks to the public printed from speeches of the strike leaders, "for walking out of sympathy," was rather rich and calls for no comment. The public was annoyed and inconvenienced, which they had no right to be, and it is hoped that the strikers and the management will settle their own affairs together and in private, should such a case occur again. Certain it is, that emboldened by the success of the Montreal Street Railway employees, others may try similar tactics in the spring; whether with success or no remains to be seen.

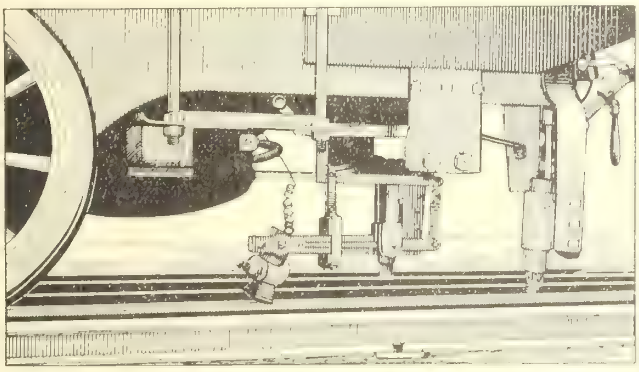
The Ontario Lantern Company, of Hamilton, manufacturers of the "Radiant Shelby" lamps for Canada, have recently decided to manufacture the Edison lamp also, which will be called the new "Brilliant." The company are now producing 1,500 incandescent lamps daily.

ELECTRIC SAFETY DEVICE FOR RAILWAYS.

A new electrical device for preventing collision between railway trains has recently been tested with some success on one of the state lines near Frankfort, Germany. Mr. Frank H. Mason, United States Consul-General at Berlin, has furnished the Government with a brief account of this advice, which seems to mark an important advance step in the solution of a difficult and perplexing problem.

The device is the joint invention of Messrs. Hubert Pfirmann and Max Wendorf, and its construction and method of operation are as follows: Midway between the rails is laid a light third rail of the ordinary T pattern, the joints of which are so connected as to form a continuous conductor. Midway under the forward part of the engine is hung the working instrument, an electrical apparatus inclosed in a square case or jacket occupying a cubic foot of space. The instrument is connected with a contact shoe (see illustrations), which slides along the third rail and by wires with a telephone and electric alarm bell in the cab of the engine driver, and a red incandescent lamp which is lighted by the same impulse that rouses the alarm bell into action. A further improvement of the device sets the electric brakes on the engine or entire train simultaneously with the alarm signal which sounds the bell.

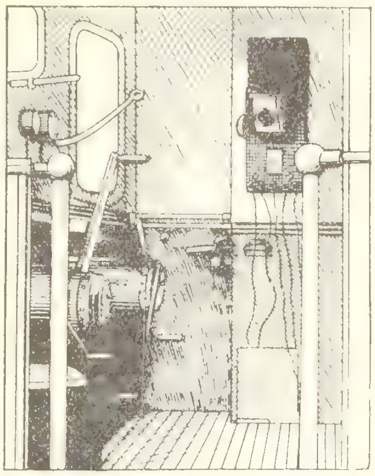
The tests were conducted on the main line from Frankfort to Hanau, between the stations Sachsenhausen and Goldstein, and a translation of the official report will illustrate concisely the working of the apparatus. Two locomotives, numbered respectively 290 and 1420, had been equipped with the new device and the experiments proceeded as follows: Engine 290, drawing a special train and approaching Sachsenhausen at full speed, received the danger signal and came to a full stop; the driver of 290 then asked by telephone the cause of the signal and received from the keeper of a grade crossing, half a mile in front, word that a wagon had broken down in crossing the track and obstructed the line. After ten minutes' wait, the engineer of 290 received word by telephone that the obstruction had been cleared away and thereupon resumed his trip.



Safety Denice for Railways.—Third Rail and Contact Shoe.

A mile farther on, the signal on 290 again sounded, and the driver was informed, by telephone as before, that the semaphore round a curve and more than half a mile distant was set at "halt". Thereupon engine 290 slowed down and proceeded cautiously, sounding its whistle at short intervals, the telephone bell in the drivers' cab ringing continuously until the curve was rounded, when the ringing ceased, notifying the engineer that the semaphore had changed to "track clear." Thereupon 290 resumed full speed.

In the tests to prevent collision, engine 1420 came up rapidly from behind and on the same track as 290, which had slowed down and was proceeding cautiously in consequence of reported danger in front. The moment that 1420 came within 1,000 meters (1,093 yards) of 290, the signal on both engines began to ring and their red lights to glow. Thereupon 1420 halted, the driver inquired of 290 in front the cause of the alarm, and a complete understanding between the two trains was immediately established. An important point in this connection is that in practice the same warning signal is sounded upon every engine equipped with the apparatus which is on the same track and within the prescribed radius—a kilometer or a mile, as the case may be—from the engine and train which cause the obstruction. If a semaphore be falsely set at safety, the train may run past it into a block in which another engine is halted or moving with perfect security that warning will be given in ample time to prevent a collision under any and all conditions of darkness, fog, storm, or mistaken instructions.



Safety Device for Railways.—Telephone, Alarm Bell and Red Light in Engine Cab.

The German Government has directed that a section of track be equipped with the apparatus for careful, practical experiments, and it is reported that the Government of Russia has obtained license to test it in actual service on its new military lines now under construction in Siberia.

CANADIAN ELECTRICAL ASSOCIATION.

The Executive Committee of this Associatio metn in Toronto on February 13th to make preliminary arrangements for the annual convention, which this year will be held in Toronto. Wednesday, Thursday and Friday, June 10th, 11th and 12th, were chosen as the dates for the convention. The local committee consists of all members of the Association residing in Toronto, with Mr. J. J. Wright as convenor.

Messrs. P. G. Gossler, of Montreal, A. A. Dion, of Ottawa, and J. J. Wright, Toronto, were appointed a committee to award prizes for papers of superior merit.

It is expected that the coming convention will be largely attended, especially by the western members, and that the programme will combine in a profitable degree instruction and pleasure.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Grounding of Secondary Wires.

The numerous fatalities from electric shocks which have occurred at various recent dates, and in locations so close as to bring the matter home to us with peculiar reality, lend increased importance to the already live point of grounding secondary wiring. The large majority of lighting work is now performed from alternating current circuits, which means that the streets are covered by a network of lines carrying a potential of not less than 1,000 volts, more likely twice this. In addition to this there are arc light lines and those of the telephone and telegraph companies, to say nothing of the overhead trolley, the whole forming a combination calculated to make one feel that crosses between the secondary and other lines carrying potentials which may or may not be dangerous, are more likely to be the rule than the exception. Further, there is the possibility of connection being made in the transformer itself, though this is rather remote, the quantity and quality of the insulation used in modern apparatus, as evidenced by records extending over a considerable period, making breakdowns of this character almost unheard of. On the other hand, it is almost impossible to guard against crosses being made outside the transformer, because storms, falling trees and broken wires may produce contacts at the most unlikely and inaccessible places. In view of this fact, that one cannot surely prevent abnormal voltages from some time or other getting onto the secondary lines, is it not desirable to absolutely prevent their power of harming the users of the service by wiring it solidly and firmly to a good ground? This may render imperative the use of better construction than is sometimes put into interior wiring, but it also means absolute immunity for those handling it, which is admittedly an end much to be desired.

A New Transmission.

The past month has seen the starting of one of the notable transmission plants of Canada, namely, the Shawinigan system, which, as our readers are aware, has sold its output for the city of Montreal to the Lachine Rapids Company. The line is the longest which is operating in this country, namely, 80 miles, there being at present but one other projected installation, that from Niagara to Toronto, which will transmit over a greater distance than this. In addition to being the longest it will also enjoy the distinction of carrying the highest line potential, 50,000 volts, now in use in this country. In this respect also it is probable that for some time to come the Toronto-Niagara line will be the only one whose voltage will be carried to as high a point as this; possibly it may be run slightly above it. Another point in which the system is unique, at any rate on this side of the line, is that the line wire is aluminum, which is but natural in view of the close business interests between the power company and that which manufactures this material. There is but comparatively little data available, as the result of experience, regarding the behavior of this metal under the extremely low temperatures which prevail during parts of the year throughout the region in which the company operates, and the results obtained will be watched with great interest by electrical interests the Continent over. Previous to their contracting for this power the Lachine Company were carrying load up to the full maximum capacity of their apparatus, so that the addition to their plant puts them in a position to now care for much more business. In this connection it is perhaps to be expected that rumours regarding rate cutting in the effort to obtain new business will be rife, but it is to be hoped that this will not come to pass. A rate war is always bad in the long run for the principals concerned, besides having very injurious effects on the business in other cities, in which the impression is very likely to get abroad, even though it may be quite unjustified, that the companies operating in these localities are asking too much for their product, and that a wholesale reduction in their prices is justifiable and to be expected by the public.

Wireless Telegraphy

The subject of wireless telegraphy is receiving a great deal of attention just now in both the technical and non-technical press. The latest aspirant to recognition is the DeForest system, the promoters of which have been giving demonstrations during the latter end of February between Hamilton and Toronto. According to the newspaper reports experiments more or less successful have been conducted at various points in the States, and at the present moment plans are practically completed for the establishment of various stations on the California coast, in view of which the object of the local demonstrations does not immediately appear. The principle at the sending end does not seem to differ very materially from that of the other systems which are being exploited, the usual high voltage transformer with condenser, spark gap, and tower being used. At the receiving end the main part of the equipment consists of an anti-coherer, so called because its operation is the reverse of the receiving device, the coherer, in other systems. This latter instrument, normally of high resistance, becomes a good conductor when subjected to the influence of a discharge and when in this condition allows the passing of a secondary or relay current which in turn gives a signal readable by the operator. On the other hand, the anti-coherer of DeForest, a mixture of oil and water, is normally a good conductor, but when a current from the receiving pole passes through it it becomes, through the formation of gas bubbles, of high resistance. The flow of current is then interrupted, this alternate starting and stopping being made audible to the receiving operator through the medium of a telephone.

In this connection Mr. Peter Cooper Hewitt has just announced another application of the principle involved in his mercury vapor lamp, this time as an adjunct to wireless telegraphy equipments. The oscillating discharges from the sending station have hitherto been produced by a condenser discharging through air across the ordinary spark gap arrangement of two brass balls. This method, while fairly satisfactory, has always been a source of difficulty in one particular, namely, that the rate of oscillating or discharging varied tremendously with variations in the state of the atmosphere and the surface of the brass spheres. This variation is most objectionable in wireless telegraphy, as it prevents a receiving instrument being turned to receive impulses from a sender operating at a given rate of oscillation, a condition obviously impossible if the rate is constantly varying. Mr. Hewitt now finds that his mercury vapor tube makes a most excellent interrupter, producing a very large number of oscillations per second and at an absolutely regular rate of speed, two most desirable points. It would thus appear as if Mr. Hewitt had discovered a principle which will allow wireless telegraphy to make more pronounced progress, and which is entitled to be classed in importance with the original investigations of Mr. Marconi.

Electric Drive for Factories.

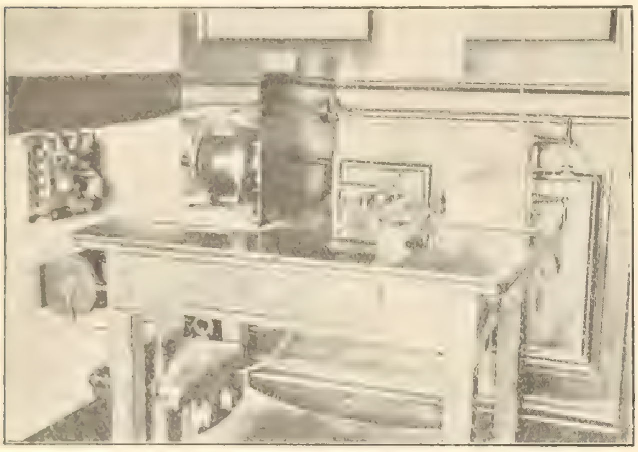
In bygone days the question of the motive power for a factory, either one in operation or one to be built, was settled with but very little discussion, one large prime mover, and perhaps very unfavorably situated at that, being the only plan available. Today there are several methods to choose from, each of which has its own particular field, but year by year it is coming to be more generally conceded that electrical driving has many points which entitle it to be considered as the most suitable in the large majority of manufacturing establishments. Users of power are divided roughly into two large classes, those who buy their power from some other public or private producer, and those who control their own steam or water plants. Those in the former division, aside from the fact that it is practically the only way in which power is offered as a commercial article, naturally use electrical machinery as their transforming agent because of its lower fire risk and greater cleanliness and convenience, but in the second case it is sometimes a moot point as to whether or no the expense of an electric distributing system is justifiable. Material for ordinary products represents approximately fifty per cent. of the cost of an article, labor or time in other less direct forms comprising some forty-five per cent. and power the balance. From this it will be seen that when considering the choice of a system mere economy of transmission is but a secondary feature, because the power item is such a small proportion of the total cost. On the other hand, presuming that any given method of power enables a reduction to be made in the item of labor, it will at once be evident that the aggregate cost will be materially affected, and modern practice is demonstrating more and more that the electric motor, by reason of the great facilities which it offers for a wide range of speed control, is a most satisfactory agent for producing this desirable end. There are, of course, a great many manufacturing processes which do not require variable speeds, but on the other hand there are an immense number which do, and to these latter the individual system of electric drive, a motor to each machine or tool, is peculiarly suited as offering a means of materially reducing the cost of the goods produced by greatly increasing the output of the various operators and the machines which they control.

The Cataract Power Company, of Hamilton, Ont., are having plans prepared for an enlargement on an extensive scale of their plant at DeCew Falls. The proposed improvements will include the enlargement of both the power house and the canal.

Messrs. James Robinson, M.P., C.J. Coster and Thos. M. Robinson, of St. John, J. McDavitt and Edward Payson Brown, of New York, are applying for incorporation as the Aluminum Production Company of New Brunswick, Limited, with capital of $1,000,000. The chief place of business will be Newcastle, N.B.

THE DE FOREST SYSTEM OF WIRELESS TELEGRAPHY.

The attention of Canadians has been drawn to the De Forest System of Wireless Telegraphy by the experiments which are now being conducted for transmitting messages between Toronto and Hamilton, and the incorporation of the De Forest Wireless Telegraph Company of Canada, Limited. It was expected that a public test would have been made before this time, but arrangements have not yet been fully completed.



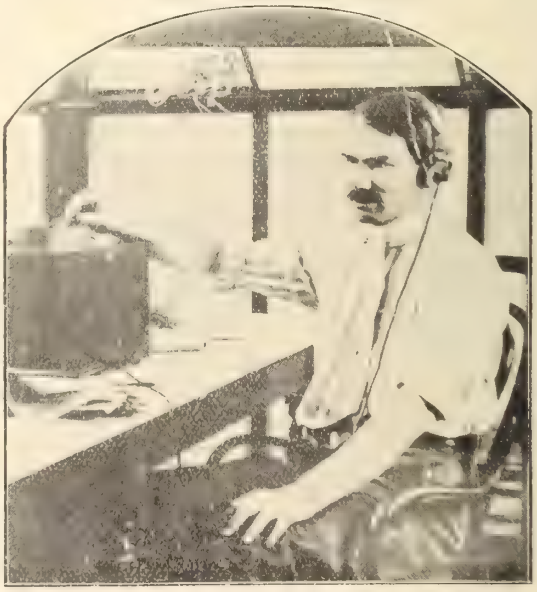
Transmitting Apparatus, De Forest System of Wireless Telegrappy.

The inventor of this system of wireless telegraphy is Dr. Lee de Forest, an American only twenty-nine years of age. He is a graduate of Yale University, where he studied electrical oscillation for six years. He entered the employ of the Western Electrical Company, of Chicago, and there continued his experiments. His first outdoor test was made in Chicago in 1901. Later he removed the scene of his experiments to New York. During the naval manoeuvres off the New England coast last summer, he established stations at Fort Wadsworth and Fort Hancock, which were bought up by the United States Signal Corps. The tests made under the auspices of the Navy Department are said to have been very successful, forty-eight words a minute being sent between Washington and Annapolis. These two stations are separated by thirty-six miles entirely overland, consisting of rough, hilly country heavily wooded. German and French wireless telegraph engineers who have essayed to cover this distance have pronounced it equal to 180 or 200 miles over salt water. The Slaby-Arco and Braun German systems and the Ducrete and Rochefort systems from France have all been tried over this range. Though exhaustive experiments were made, the Slaby-Arco system was, it is said, the only foreign system which was able to transmit intelligible messages, and this only after careful tuning of the two sets of instruments. The De Forest apparatus was in use by the Naval Board three weeks, and no difficulty whatever was experienced in covering the distance from the start. No tuning was required. This results from the extreme sensitiveness of the De Forest receiver and the positive and powerful action of the transmitter employed.

The De Forest anti-coherer, being a current-operated device, is best placed at a current loop or static node, that is, at the base of the antenna, which, it is said, accounts for its operating where the coherer, or potential-operative device, is uninfluenced. Inasmuch as the attaching of an earth connection to one side of the receiver compels a static node there, it was found that signals continued to be received, even when a length of wire, inductive or non-inductive, was inserted between it and the base of the antenna, even when this length amounted to that of the antenna, or more.

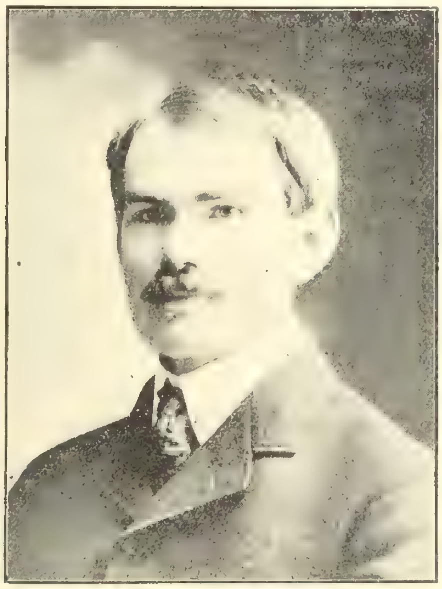
At Annapolis and Washington the Navy Department had masts 180 feet in height. From these hung a fan of five wires, of an average length of 200 feet. The ground connections consisted of two copper plates, 2 x 6 feet each, buried 6 feet below the surface. During the tests an officially recorded speed of 35 words the minute was maintained, and many of the test dispatches were in the Navy Code. Press dispatches were continually exchanged, and the value of "wireless" as a news transmitting medium was interestingly demonstrated when, after the runaway accident to Secretary of the Navy Moody, at Annapolis, the De Forest operators at Washington had the news to the press and the Navy Department fully thirty minutes before it was known by telephone or telegraph.

The ideas embodied in the receiver and sender have done away entirely with the coherer at the receiving station and the induction coil at the sending end. In the coherer heretofore almost invariably used as the receiving instrument in space telegraphy, the great drawback is the necessity for a tapping or decohering device, with the complication of apparatus this involves, its uncertainty of action, and, most important of all, the time lag, with limited speed of signal transmission thus made inevitable. To the new receiving device its inventor has applied the name "responder", a term first suggested as one suitable for any resistance device sensitive to electric radiations, regardless of any theory of the particular action involved. The device is not an "anti-coherer", for, although the action of the electric waves upon the new receiver is to cause a sudden increase in its resistance, similar to that observed with the arsenic or lead-peroxide "coherer", yet this effect is due to an entirely different action. Just what this action is and the mode of operation, as well as the full theory involved and the conditions governing, have been the subject of careful and painstaking scientific



Receiving Apparatus, De Forest System of Wireless Telegraphy.

research. The responder appears to be extremely sensitive in its action, and is instantly and automatically restored to its normal condition of high electrical resistance at the cessation of the Hertz impulse. This automatic restoring quality of the responder allows an ordinary telephone receiver to be used to good advantage at the signal receiving device. In this one hears, as it were, the sound of the spark at the sending instrument, for however rapidly these sparks follow one another, the responder restores itself to its original condition after each, and is thus able to respond to the succeeding impulse. Thus, by employing an induction coil and Wehnelt interrupter with an adjustible platinum anode, for the sending instrument, a sort of crude musical scale or siren can be operated, and the same note is heard ascending or descending, by one listening at the telephone connected in the responder circuit. In telegraphing, the receiving operator hears the dots and dashes of the Morse code in short or long "ripples", very much as the sending operator hears it in the sound of the induction coil's spark. This automatic restoring quality of the new responder, therefore, allows a speed of signal transmission limited only by the ability of the receiving operator to read. If desired, an ordinary relay may be substituted for the telephone and the signals received on the Morse sounder. The telephone is preferred, however, on account of the greater simplicity of the receiving circuit thus made possible, comprising, as it then does, beside the responder, only choke coils, the necessary resistance, a cell of battery and the telephone. The responder has been found to work best on a small current. Thus, with one ordinary dry cell several thousand ohms' resistance is included in circuit. The normal resistance of the device is about 50 ohms, increasing to 1,000 or more under the influence of the electric impulse.



Dr. Lee De Forest,
Inventor of the De Forest System of Wireless Telegraphy.

The De Forest system makes no claim to syntonic methods, but introduces several novel features. It is the only system using a generator of the transformer type; current from an engine-driven alternator having a potential of 500 volts is stepped-up by a commerical transformer to a voltage of 20,000 or higher, the oscillator is connected in series with the antenna and earth and is of the open-circuit type; the resonator is also of the B. C. type, and operates an anti-coherer, through a transformer, as in the Marconi, Braun and Guarini receivers; the impulses are translated into Morse by head telephones through the responder like that of the Slaby-Arco portable system.

THE BELL TELEPHONE COMPANY.

The annual meeting of the Bell Telephone Company was held in Montreal on February 26th. The statement for 1902 showed that 5,623 subscribers were added during the year and that the total number of sets of instruments now earning rental are 48,481. The company now owns and operates 377 exchanges and 553 agencies; 2,655 miles of wire were added to the Long Distance system in 1902; of these 1,042 are in the Ontario Department, 1,240 in the Eastern Department, and 373 in the North-Western Department. The long distance lines now owned and operated by the company comprise 26,848 miles of wire on 6,991 miles of poles.

The total receipts for the year were $2,085,134.26 and the expenses $1,580,831.39, leaving a net revenue of $504,282.89, from which was paid out $411,860.40 in dividends.

Officers and directors for the ensuing year have been elected as follows: C. F. Sise, president; Hon. R. MacKay, vice-president; Robert Archer, Hugh Paton, Charles Cassils, F. P. Fish, W. R. Driver and Thomas Sherwin.

Additional property adjoining the head office in Montreal has been purchased, and at an early date a new building will be erected to meet the requirements of the growing business of the company.

THE LINEMAN.

Thin scattered ranks of snow
  Stampede along the street,
And sagging wires betray the slow,
  Chill mischief of the sleet.

In homely garb of toil,
  With tools of quaint device,
The lineman comes, his shouldered coil
  Grey with a rime of ice.

Unpraised adventurer,
  He climbs enchanted towers,
And mends the magic threads that stir
  Tne world's remotest powers.

From heights wind-desolate
  His torch-flame cheerless blue,
(Red, red the hearth where loved ones wait
  The winter twilight through).

Lineman, what hindereth
  That message I would hear?
Canst mend the web 'twixt Life and Death?
  Canst gain responses clear?

I call, but still behold
  No spark of answering fire;
Oh, for some lineman true and bold
  To mend that broken wire!

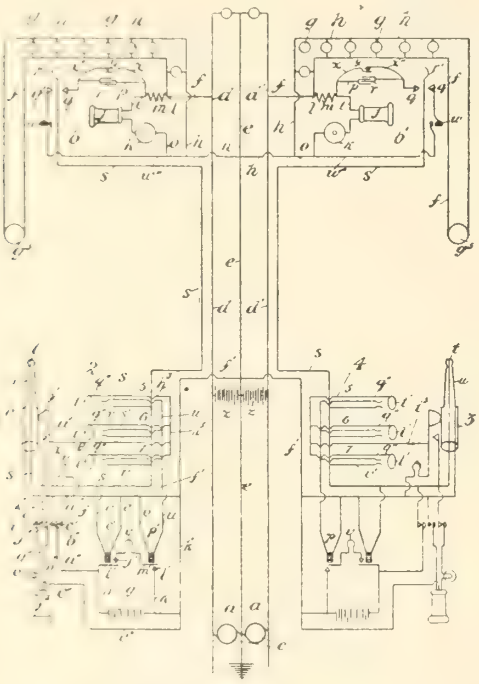
—William Hurd Hillyer, in Lippincott's Magazine.

The citizens of Sydney, N. S., recently tendered a banquet to Signnor Marconi, which was one of the most successful functions of the kind ever held in the Maritime Provinces. The dining room of the Sydney Hotel was beautifully decorated with flowers and the electrical display was on a most elaborate scale. At opposite ends of the table were placed two miniature Marconi towers, representing respectively the stations at Table Head and at Poldhu, Cornwall. Between these two stations an electric spark flashed at intervals, signifying the passing of wireless messages. The distinguished inventor, in responding to the toast of the evening. stated that the cost of establishing a trans-Atlantic wireless telegraph service was less than $200,000, while it cost $4,000,000 to lay an Atlantic cable. His company were under contract to transmit messages for ten cents a word, but he would not be surprised if in the near future wireless messages were flashed across the Atlantic at a cost of a cent a word.

COMBINED TELEGRAPH, TELEPHONE, ELECTRIC LIGHT AND POWER SYSTEM.

Mr. Alexander McMartin Stark, superintendent in Toronto for the Bell Telephone Company, has patented a novel system by means of which a subscriber is furnished with electric light, power and communication over the same circuit at the same time. In carrying out the purpose of the invention Mr. Stark uses a power current transmitted over a main power circuit and distributed at each subscriber's station to the subscriber's main circuit to furnish him continuously with current for his lamps, motors, and communication instruments and maintain this power current at constant tension by storage battery bridged across the main power circuit between the generator and subscriber's station. The accompanying drawing represents a diagrammatic view of a complete system of distribution.

In the drawing (a) is the generator station, which may contain any number of switchboards, and (b) (b') the subscriber's stations. Connecting the generator station with the subscriber's station is a three-wire circuit consisting of two main conductor wires (d) (d') and a main return wire (e). Tapping the main-conductor wire (d) and leading to the subscriber's station (b) is the subscriber's conductor wire (f), in circuit by means of the subscriber's return wire (h) with the main return wire (e). Connected in parallel with the subscriber's conductor and return wires are a series of lamps (g) and a motor (g^{5}). The electric current continuously circuits over the main-conductor wire (d) to the subscriber's conductor wire (f), through the lamps (g), subscriber's return wire (h), to the main return wire (e). Tapping the subscriber's conductor wire (f) is the telephone conductor wire (i), leading to the telephone receiver (j), in circuit with the telephone transmitter (k), which is connected with the subscriber's return wire (h) by the telephone return wire (o) and interposed in the circuit between the tap (l) and receiver (j) is a resistance (m). The telephone hook (r') is connected to the line wire (s), leading to the tip (t) of the plug (u), and connected to the line wire (s) is the conductor wire (a') of the signal-lamp relay (c').



Combined Telephone, Telegraph, Electric Light and Power System.

The subscriber's signaling device (w) is tapped on the subscriber's return wire (h) by the wire (w″), and when the receiver is on the hook (r') the circuit for the current is established over the line wire (s) from the central station through the hook (r'), contact point (q), subscriber's signaling device (w), and wire (w″) to the main return wire (e). Connected with the condenser conductor wire (p) are the wires (x) and (x″), forming the telegraph circuit, in which is interposed the usual telegraph instruments (y). Interposed on the condenser conductor wire (p), between the telegraph-circuit wires (x) and (x″), is a condenser (r), the purpose of which is to prevent the interrupted current of the telegraph instrument being transmitted to the receiver of the telephone instrument. When the receiver has been removed from the telephone hook (r'), the circuit from the central station is from the tip (t) of the plug (u), line wire (s), telephone hook (r'), contact point (q), condenser conductor wire (p), telephone conductor wire (i), receiver (j), and transmitter (k) to the telephone wire (o) and main return wire (e), and also over the telegraph circuit, the telegraphic messages being received and transmitted over the telephone circuit when the telephone hook is in this position. A similar system of circuits is installed in the subscriber's station (b').

Bridged on the main power circuit is a storage battery (z) to aid in maintaining constant pressure of the current as it circuits from the generator to the subscriber's stations and to remove the effects of the imperfect commutation of the generator and destroy the individual vibrations of the current by a neutralization of the same. At the subscriber's stations the current continuously passes over the subscriber's conductor wire (f), through the electric lamps (g) and motor (g^{5}), to the return wire (h) and main return wire (e). The current through the lamps and motor is not interrupted to any noticeable or appreciable extent by the cutting in of the telephone or telegraph instruments, or, in other words, the circuit of the current from the generator through the lamps and motors is continuous and of a sufficiently high potential to perform the work required of it. At the tap (l) sufficient current is taken off the power circuit to operate the telephone and telegraph instruments and passes through a resistance (m) to protect the telephone and telegraph instruments against its high potential. The current circuits continuously from the resistance (m) through the telephone conductor wire (i), receiver (j), transmitter (k), telephone return wire (o), to the main return wire (e). In the case of the telephone, the circuit of the current is constant through the instruments, while in the case of the telegraph instrument, the circuit of the current is interrupted until the telephone hook (r') engages the contact point (q).

Assuming that subscriber's station (b) desires to communicate with subscriber's station (b'), the receiver is removed from the telephone hook (r'), when a circuit from the generator (a) is established over the subscriber's conductor wire (f), resistance (m), condenser and telegraph circuits to the contact point (q), hook (r'), and line wire (s) to the signal lamp (v). The operator at the central station, after the lighting of the signal lamp, brings the contact points (i″) (j″) into engagement with the contact points of the branch wires (k″) (l″), respectively, forming a circuit from the line wire (s) through the operator's instrument at the central station and line return wire (t') to the main return wire (e), putting the operator's instrument into communication with the instrument at subscriber's station (b). The generator current from subscriber's station terminates in the tip (t) of the plug (u), and the operator on being requested to connect subscriber's station (b) with subscriber's station (b'), inserts the tip (t) of the subscriber's plug (u) into the jack (t') of the subscriber's station (b').

On the removal of the receiver from the telephone hook at subscriber's station (b') the circuit of the current through the signaling device is broken and is established over the condenser conductor wire and through the condenser to the telephone instrument and also over the telegraphic circuit and then over the telephone return wire to the main return wire (e). The subscriber at station (b) is now in communication with the subscriber at station (b'), the generator (a) continuing to furnish the current for the operation of the instruments, as well as for the operation of the lamps and motors at both stations. When the plug (1^{0}) is inserted in the jack (4) the calling subscriber's spring (x') moves against the contact point (a^{3}), and establishes a circuit from the generator (a) over the line wire (s) through the disconnect lamp (w'), to the line return wire (f'), the spring (x') and contact point (a^{3}), forming part of the plug switch. When the generator circuit from the subscriber's station (b) is broken by the receiver being hung on the telephone hook (r') at subscriber's station (b), the circuit through the disconnect lamp (w') is broken and the operator is signaled that the instruments are no longer in use, and the plug (1^{0}) is then disconnected from the jack (4) and returned to its socket.

Montreal is to be the headquarters of the Canadian Marconi Company, which is now preparing to install a wireless transcontinental service throughout the Dominion. Mr. John D. Oppe, of London, Eng., who is to become the manager of the Canadian company, is now fitting up a suite of offices in Montreal.

QUESTIONS AND ANSWERS

"Engineer": What is the rule for finding the horse power transmitted by leather belts? What is the proper speed to run them at? Which side should run next to the pulley?

Ans.—Various belt makers give different figures for the power which their products will transmit, but for average heavy double belts, running at four thousand feet per minute, a safe load is 10 to 12 horse power per inch of width. The power transmitted will increase or decrease in direct proportion to any change in this speed. A speed of 4000 feet per minute is considered good practice, speeds appreciably above or below it being considered on the one hand too high to give entirely satisfactory service, on the other too low to make the cost of belting come within reasonable limits. In single belts, the hair side should run next to the pulleys, on double belts you must run a hair side on both the inside and outside, because the two flesh sides are glued together.

"J. R.": Will a generator heat more on a load of say 500 kilo. volt amperes when the power factor is 100 per cent. and it is therefore delivering 500 k. w. to the circuit, than it will with the same apparent power but at a lower power factor, in which case the actual energy delivered is less?

Ans.—The heating will be greater in the latter case. This at first sight seems peculiar, but it is due to the fact that the less the power factor the greater is the magnetizing current required, from which it follows that the copper losses in the field, and all the iron losses, due to the increased magnetic flux, are both increased. The foregoing is true only if the decrease in the power factor be due to a lagging current, which we presume is the case in the machine you mention. If the current be leading, while the power factor will still be less than unity, the heating will decrease because the magnetizing current and flux will both be less.

"Marine Engineer": I want to put in a small lighting plant on a boat carrying 165 pounds of steam. Can I get a small engine to work off that pressure?

Ans.—It is not likely that any engine builder would care to sell his product to operate as a single cylinder engine off any such pressure, and a compound in any size smaller than say 100 horse power is not considered good practice, but you can get a plant which will give you good service by installing a reducing valve to bring your steam pressure down to say 80 or 90 lbs. Any ordinary single cylinder engine, condensing or non-condensing, will work on this pressure.

"Lineman": What is the difference between the drop and the loss in any given line of wiring?

Ans.—There is no difference in direct current work, they being identical. In alternating current circuits the loss is the power which is actually absorbed or lost in forcing the current through the wires, and is numerically equal in watts to the resistance of the line in ohms multiplied by the square of the current in amperes, which is also the rule for finding the loss or drop in direct current circuits. The drop in alternating current lines is the difference between the voltage delivered by the generator to the line and that received at the other or load end. It is equal to the volts consumed by the resistance of the line (the loss) plus that consumed by the reactance, which may or may not be considerable, depending on the size of the wire, the current passing through it, the frequency and the distance between the wires. It will thus be seen that it is always slightly greater than the loss, sometimes considerably so.

"Student": What is the meaning of the terms "long shunt" and "short shunt."

Ans.—The term short shunt means that in a compound wound machine the shunt field is connected directly to the armature brushes, in which event the current in the shunt field does not go through the series winding. In the long shunt the opposite is true, the shunt winding being connected to the other end of the series field. The terms are almost obsolete now. There is not much difference between the two methods of wiring, as far as actual operation is concerned, though the latter allows of the machines being excited direct from the bus bars, which is sometimes a desirable feature.

"J. King, Toronto": Can you inform me through your columns if water wheel governors have been controlled at a distance, electrically or by other means, anywhere in Canada or United States? If so, how is the same accomplished?

Ans.—The Lombard Water Wheel Governor Company have a type in which the speed is lowered or raised at will by a small motor, placed on the governor itself, and which is controlled by a switch placed at any convenient point, irrespective of the location of the governer; there may be more than one switch if it is found desirable to handle the governor from two or more points. The principle on which the device works is that the motor, when moved in one direction, shortens the length of the fulcrum on which the governor balls swing, when rotated the other way the opposite result is attained. The same device, with slight modification, can also be used to start or stop the wheel from any point desired.

"Reader": Will you kindly inform one of your readers if the larger companies throughout Canada use a double busbar arrangement on their switchboards and if these busbars are ever arranged so that they can be sub-divided. If this is done, can you tell me which of the larger companies in Canada use the arrangement?

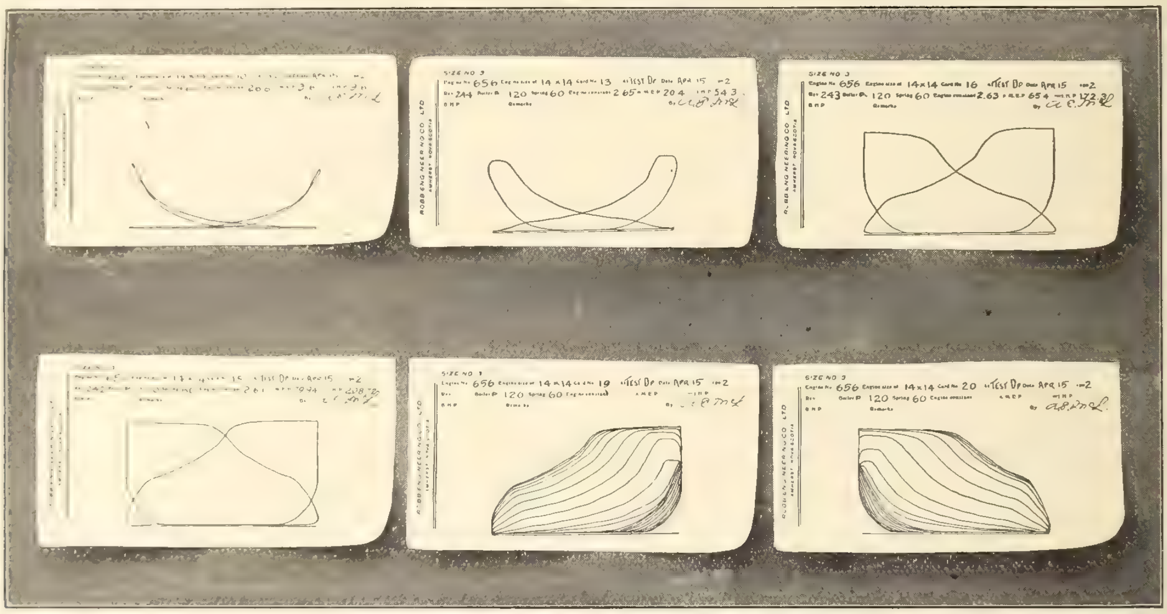
Ans.—The use of double busbar equipments cannot be said to be common practice in Canada, though some of the larger companies use it. Among them may be enumerated the London Electric Company, the Hamilton Electric Light Company, the Ottawa and Hull Power Company, the Jacques Cartier Electric Company and the Montreal Light, Heat & Power Company. The latter company is the only one as far as we are aware who in addition to having the two sets also have means of subdividing them.

INDICATOR CARDS.

We show on this page a set of indicator cards taken from a Robb-Armstrong single valve engine, which are almost as perfect as can be obtained from a four-valve engine.

These engines have a special form of rocker arm, designed by Mr. A. G. Robb, general supsrintendent of the Robb Engineering Company, by which the valve is moved more quickly at one end of its stroke than at the other, thus overcoming the irregularity in the time of admission and cut-off due to angularity of the connecting rod, which causes the piston to move faster at the back end than at the front end of the cylinder, and which in single valve engines with the ordinary valve gear, gives irregular indicator cards.

The Robb Engineering Company has recently issued a very attractive catalogue, fully illustrating and describing their engines, also giving views of some of the power plants they have erected in different parts of the world, and we have no doubt they will mail a copy to any person desiring one. Their address is Amherst, N. S.



Indicator Cards from a Robb-Armstrong Engine.

THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY.

The report of the Lachine Rapids Hydraulic and Land Company, of Montreal, submitted at the annual meeting on February 12th, showed a gross revenue for the year 1902 of $429,936.94, which was augmented by emergency revenue due to the Chambly dam accident to the amount of $36,027.64, making a total of $465,964.58. Discounts of $90,437.89 to customers reduced the total to $375,526.69. The operating expenses were $112,012.68, and the amount expended on betterments and repairs was $13,831.57, making a total of $125,844.25, leaving a balance of $249,682.44. After deducting interest charges and making provision for bad and doubtful debts there was left a net profit of $220,952.11. The addition of balance of profit and loss increased that amount to $228,733. Two half yearly dividends of 3½ and 4 per cent., amounting to $147,817.50, were paid, and the following contingent accounts were provided for: Written to credit of meter and arc lamp contingent account, $10,054.47; carried to contingent account, $30,000.00; carried to profit and loss reserve account, $36,027.64; balance carried forward to profit and loss, $4,833.39, a total of $228,733. The credit to the contingent fund on December 31, 1902, was $91,070. The percentage of total expenses decreased 4.75 per cent. last year, from 34.02 per cent. in 1901 to 29.27 per cent. last year. In 1899 they were 44.16 per cent.

The following statement of connected loads was submitted:

	1900	1901	1902	Increase.
Incandescent lamps.....	71,500	87,818	105,348	17,530
Alternating arcs........	205	321	392	71
H.P. of motors connected	2,716	3,280	3,699¼	389¼
Town of Lachine	......	150	185	35

In addition to the above, some fifteen fans and eight heating irons are connected.

There was expended during the year on account of capital $273,424.29. This includes steel floor in power house, conduit system and cables, cost of transmission, distributing lines, transformers, motors, switchboard, dams, head and tailraces, extensions to and connections with the Shawinigan station, out of which the amount of $21,817.92 was spent for meters alone.

During the year the company laid 20,371 duct feet of vitrified conduit, three hundred feet of 3" wrought iron pipe and five manholes, and installed several ducts. There were placed during the year 19,397 feet of cable in the city and suburbs.

On the subject of inspection the report says: "Your directors regret that little or no progress has been made by The Canadian Fire Underwriters to ensure proper inspection of electric wiring and a better class of work. Your company is continuing to exercise, in so far as its interests are concerned, the greatest possible care, but our efforts seem to be fruitless and not appreciated by the Fire Underwriters, nor in some cases by the interested parties."

Officers have been elected for 1903 as follows: President, G. B. Burland; vice-president, Alex. Fraser; managing director, W. McLea Walbank; secretary-treasurer, Robt. Whyte.

At the annual meeting of the Citizens' Light & Power Company, Montreal, Messrs. G.B. Burland, Peter Lyall, W.M. Walbank, J. H. Burland, R. Wilson-Smith, M. P. Davis and L. H. Henault were elected directors, and at a subsequent meeting of the directors Mr. Walbank was elected president, Mr. J.H. Burland vice-president, and Mr. Robert White secretary-treasurer.

THE ENCLOSED ARC LAMP.

By Ralph Scott.

It is not the purpose of this article to elaborate on what has already been said regarding the enclosed arc, but merely to sum up in a general way, for the convenience of the average reader, the good points and principles of this type of lamp.

In the ordinary open-arc lamp the carbons burn or waste away so rapidly that for a single night's illumination (with the series street lamp) two sets of carbons are required. Hence the advantage of the enclosed lamp, in which a single set of carbons burns from 150 to 200 hours. In order to accomplish this it is merely necessary to enclose the carbons, or at least the arc, in a glass globe, so that the outside air will have no chance to act on the carbon at the arc. If this be done with a series lamp, however, it will be found that the light given off is greatly decreased, the reason for which will be explained later. If all the air be excluded from the arc, it will be found that the disengaged particles of carbon will float around in the globe and finally deposit themselves upon the sides and bottom of the globe and in a short time shut off a great deal of light from the arc. It is therefore obvious that a little air is necessary to circulate in the globe or bulb, so that this uncombined carbon may be oxidized. Moreover, if the globe were made perfectly air-tight the expanding gases would cause an explosion. The combination of the carbon and the air forms carbon dioxide, which is harmless so far as blackening the globe is concerned.

In order to obtain this limited supply of air, a small opening should be left in the globe or above it, through which a small quantity of air may find admission. This may be accomplished by leaving a small air space between the upper carbon and the cap into which it slides. On no account must an opening be left in the bottom of the inner globe, since the globe will then act as a chimney and the carbons will be consumed much faster. It is therefore important to have no nicks or cracks in the bottom of the inner globe.

Even when a little oxygen or air is admitted to the globe a small quantity of silicon and calcium, which are found in even the purest carbons, will form on the inside of the globe and shut off a little light, but in some cases this seems to improve the color of the light. This deposit may be readily washed out by dilute hydrochloric acid every few months, and will not be found to give much trouble. Sometimes this acid seems to attack or affect the glass in such a way as to greatly increase its liability to crack by uneven heating ; therefore, it should only be used when absolutely necessary.

In the open arc, if the upper carbon be raised so as to increase the potential across the arc to 80 volts, it will be found that a flaming, hissing and very wide arc is the result, and the carbons will waste away very rapidly owing to the free access of the oxygen of the air to the arc, which now gives off a great amount of heat, but very little light. If the arc were enclosed the action would become entirely different, the arc assuming a quiet, non-hissing, non-flaming condition, because of the greater number of uncombined carbon molecules ; and, being more compact and offering more resistance, the arc gives much more light and less heat. The light produced by an enclosed arc is due chiefly to the incandescence of the carbon vapor, while in the open arc the light given off is produced chiefly by the incandescent carbon tips, which are heated by the combustion of the carbon vapor.

As a higher voltage is required to force current across the longer arc of the enclosed lamp, the e. m. f. may be advantageously increased to 80 volts in a 5-ampere lamp ; in fact, it must have this potential across the arc or it will not yield the characteristic results of this type of lamp. All attempts at changing series lamps into multiple enclosed lamps have been failures for this reason. Some lamps may be adjusted to increase the length of the arc sufficiently, but in most types this cannot be done, and an enclosed lamp having only 50 or even 55 volts across the arc is a failure, since it sometimes gives only a little more light than an ordinary candle.

A 3½-ampere enclosed-arc lamp, with 80 volts across the arc, gives about the same effective light as a series lamp using 7 amperes at 45 volts, so that the efficiency is much in favor of the former type. Enclosed lamps are generally connected in multiple across 110 and 220-volt circuits and in series of two and five across 220 and 550-volt mains. The standard 220-volt lamp takes 155 volts across the arc and passes 2½ amperes ; the 110-volt lamp takes 80 volts at 5 amperes, the length of the arc in the latter case being about 13/32 in.

In an enclosed-arc lamp with a shunt coil, the dashpot must be stronger than in the series lamp with a shunt coil, so that the movements of the carbon will not be too sudden or spasmodic. If this provision is not made, the arc will be disrupted or broken, causing the lamp to "wink." In the alternating-current lamp, on account of the low heat of the arc and its tendency to blow itself out, the damping or dashpot action must be very slow, and the moving parts must have considerable weight, which provision is unnecessary in direct-current lamps. The disadvantages of alternating current arc lamps are singing at the arc and in the mechanism and poor regulation ; in later lamps, however, these troubles have been reduced to a considerable extent.

Another point worth consideration is the hissing in arc lamps. This pecularity is seldom observed in an enclosed-arc lamp except at the start while the inner globe is full of air. Hissing is due to several causes, chief among which are the following : The carbon, especially at the crater, is in a state of ebullition ; if the current taken by the arc is great, or if the arc be very long, the arc, having so much surplus vaporized carbon, is attacked, especially at its widest position, by the oxygen of the air, resulting in minute explosions or combinations of this carbon oxygen, which occur with such great rapidity as to cause a hissing vibration ; if the current used is too great, however, the noise of the arc will then assume a humming or purring character.

In the enclosed type the distinction between the crater and cone is not very marked ; in fact, it is almost impossible to tell the difference between the positive and negative carbon tips, both having a rounded appearance. At the moment when the current is shut off from the lamp, it will be noticed that the positive carbon tip is the hotter or stays red the longer, which is the test applied to determine whether the lamp is connected correctly or not. When taken out, the carbon tips possess a smooth, perhaps polished appearance, and are generally cracked. The carbons should never be rough, as this indicates that too much air gets into the inner globe.

The carbon tips from the non-hissing open arc possess the following properties : The cone is tapered to an angle of about 70 degrees and has a small knob of carbon deposit at its end ; the crater is uniformly hollowed out and covers the greater part of the end of the positive carbon, and there are no fringes on either tip. If the tips do not show these characteristics, then it may be assumed that the arc has been hissing or has been passing too much current.

A curious effect in an arc-lamp circuit is the following : Upon opening the circuit there is seldom more than a very small arc at the switch. The reason for this is that any arc, however small, quickly introduced in series with a lamp will immediately break the circuit. For this reason a considerable number of arc lamps will give no more spark at the switch break than an equal number of incandescent lamps. Hence, the switch will not have to stand a very heavy arc on opening the circuit. By reason of this feature, considerable economy may be effected by using snap switches for this purpose, this type of switch having a longer life than others.

The following rules should be observed by those who have any arc lamps under their charge or attention :

1. Always have the top carbon positive, that is, hottest.
2. Never allow the dashpots to stick.
3. See that the upper carbon does not bind.
4. See that the clutch works reliably and smoothly.
5. Throw all cracked, "run" or nicked inner globes away.
6. Keep all contacts tight.
7. Use no undersized or crooked carbons.
8. Keep asbestos washers in perfect condition.
9. Always have strong supports for suspending the lamps.
10. Do not allow resistance wires or coils to sag.

—American Electrician.

WATER POWER IN FRANCE.

An event marking a new era of prosperity for Grenoble and the region of the Dauphine was the holding in September of this year of a "white coal" convention. More than 500 prominent men of science —engineers, polytechnists, mill owners and manufacturers—from France and other countries assembled in the Chamber of Commerce building and devoted their time to a thorough discussion of the utilization of the water power of the glaciers and mountain streams of Alpine France. During the week excursions were made in different directions within a radius of 50 miles to inspect the score or more of factories, where the water is already utilized for the generation of electricity, the making of paper, soda, aluminum, acetylene, and chemical products of various kinds, and in general for the distribution of force.

The railroads of France (25,000 miles) employ about 4,000,000 horse power and the other industries about 2,500,000 horse power—a total of 6,500,000 horse power produced by steam. M. Berges estimates the hydraulic forces of France in her mountainous regions to be 10,000,000 horse power. Even at a much reduced estimate, the measure of industrial development possibly can readily be seen.

The streams and cascades have been used to a certain extent for years, but not until recently, under the leadership of such enterprising men as Berges and Joya and Desprez, has this water been "canalized"—conducted by huge pipes from vast heights down the mountain sides—and, with the aid of turbine wheels, made to develop tens of thousands of horse power and to distribute energy, heat and light in all directions.

It is a striking fact that the mighty energy cradled in the glaciers of the mountains and lying dormant through the centuries should be suddenly set free and made to turn the wheels of a hundred industries to meet the needs of man. The glaciers are a mine of "white coal" which, unlike the product of the earth, is inexhaustible, renewing itself from year to year. In 1863, it was deemed a bold achievement to bring water from a height of 260 feet, as at Uriage ; but now M. Berges has succeeded in canalizing a fall of 1,640 feet and another of 1,804 feet. At Epierre (Savoie), M. Joya used a fall of 1,935 feet and at Chapareillan (25 miles from Grenoble) another of 2,040 feet—until this year said to be the highest single fall in the world.

At Lancey, a few miles northeast of Grenoble, the water which gives power to mills of various kinds and to the electrical plant which lights the valley of the Graisivairdan and maintains its several tramway systems is brought by three successive falls whose total is 6,560 feet.

Light is furnished to the houses and farms of the vicinity at a very moderate cost ; for example :

First lamp, 10 candlepower, per year..........	$4.82½
Second lamp, 10 candlepower, do..............	2.89½
3 lamps of 5 candlepower each, do.............	2.89½
Total for 5 lamps, 35 candlepower......	$10.61½

An average of $2.12 per lamp per year.

Starting from the little lake of Domenon, among the snows of the peak of the same name, the water is drawn by pipes which tap the lake at its bottom and is carried to a lake lower down the mountain, and from this still farther down to a third lake, whence the conduits bear it, always at a certain gradient, to the factories below, where it yields an equivalent of 10,000 horse power.

As illustrating the enormous pressure of the water thus canalized, the pipes in many cases (as below) are as much as 3 meters 30 millimeters, or 10.83 feet, in diameter. The tunnel under the Thames at London has a diameter of about 11 feet, but this is for a distance of 30 meters, or 98½ feet, only. The Societe Hydro-Electrique de Fure et Morge at Grenoble, which utilizes the waters of the torrent Drac, near Vizille, has 4,600 meters, or 15,092 feet (of which 8,200 feet are in steel plates and 6,892 feet in wired cement), of piping with a diameter, as stated, of 10.83 feet.

This installation permits the distribution of force to the extent of 3,500 horse power, under a tension of 26,000 volts, for a distance of 40 miles to factories in Moirans, Voiron and Rives.

Grenoble will soon be lighted by electricity, the power being supplied by the Electro-Chemical Society of the Romanche, which has its works in the village of Livet (altitude 1,794 feet), 27 miles distant from this city. The valley of the Romanche was, until recent years, sparsely populated ; to-day, within a distance of 12 miles, there are already installed six establishments for the making of paper, wood pulp, acetylene, aluminum, etc., and for the generation of electric force.

The stream itself is fed by the powerful glacial reservoirs of the Massifs of the Belledonne and the Pelooux—ranges of mountains (in altitude from 9,800 to 13,000 feet) on either side of the valley ; and in winter and summer alike, this water supply is unremitting and abundant.

With Grenoble thus lighted as it were by the melting snows, and furnished with a new motive force for turning its industrial wheels, it may well deserve its title of "the White Coal Capital."—Report of C. P. H. Nason, U. S. Consul, at Grenoble.

STEAM ACCOUNTED FOR BY THE INDICATOR.

The expression which forms the title of this article is frequently used in connection with the reports of engine tests, and it sounds very complicated to the amateur engineer, but it refers to one of the most simple things that are given high sounding names.

If none of the steam was wasted on its way to the cylinder, nor in the cylinder after it arrives there, the steam accounted for by the indicator would equal the amount of water pumped into the boiler, but the difference is frequently 30 per cent., and sometimes it is much more.

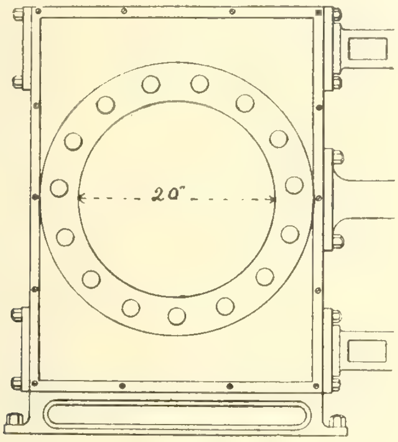


Fig. 1.

However, we do not need to trouble ourselves about this difference now, as the two qualities refer to different things altogether, which have no connection in many cases.

The cylinder of a steam engine measures the steam out of a boiler the same as a milk man measures milk out of his large cans with a quart measure. When we know the amount taken out at each stroke and the number of strokes per minute, we can decide how many cubic feet are used in that time, and multiplying this by 60 gives the consumption per hour, in cubic feet. Finding the weight per cubic foot due to the stated pressure, and multiplying these two factors together, gives the weight used per hour.

The process is illustrated as follows: Let Fig. 1 represent the cylinder of an engine, with the head removed. Measuring this we find it 20 inches in diameter. The area is 20 x 20 x .7854, equals 314 square inches.

Replacing the head and proceeding to take a diagram gives the result shown in Fig. 2. There are two ways of measuring the steam that are commonly used in practice, one of which is to find out how much is used up to the point of cut-off, and the other is to take the whole capacity of the cylinder, using the terminal pressure for this purpose. We believe this is the best plan, but will explain the other first.

The point of cut-off took place at seven-eighths of an inch from the end of the diagram, which was originally four and one-half inches long. This means that the cut-off took place at one-fifth stroke. As this engine has a stroke of forty-two inches the cut-off took place at 8.4 inches, therefore in order to find the cubical contents of the cylinder up to the point of cut-off, the area in square inches is multiplied by the length traveled by the piston when the cut-off valve closed, and as the result should be stated in cubic feet it is necessary to divide by 1,728. Then 314x8.4÷1,728 1.526 cubic feet.

This engine revolves eighty times per minute, making 160 strokes. Then 1.526x160=244.16 cubic feet per minute, or 14,649 per hour.

There was a No. 40 spring in the indicator when this diagram was taken, therefore by measuring from the atmospheric line to the point of cut-off, with a No. 40 scale, the pressure is found to be 98 pounds, but we must know the absolute pressure for all of these calculations, which is 15 pounds more than the gauge pressure in all places near the sea level, and 98+15=113 pounds.

One cubic foot of steam at 113 pounds pressure weighs .2586 pound, therefore the total weight per hour is 14,640x.2586=3,875 pounds.

The area of this piston is 314 square inches, and its speed is 560 feet per minute, therefore the horse power constant is 314x560÷33,000=5.328. The mean effective pressure is 52.4 pounds, therefore when this diagram was taken the engine was developing 5.328x52.4=279 horse power. Dividing the total weight accounted for by the horse power developed shows that 3,786÷279=13.5 pounds are accounted for per horse power per hour. This is a very low result, but is correct according to this rule. If we add 30 per cent. for condensation, etc., it brings the total up to 17.5 pounds per hour for each horse power developed.

Proceeding to illustrate and explain the rule for finding the water accounted for, taking the pressure at release, or in other words at the end of the stroke, we must find the cubical contents of the whole cylinder. The area is 314 square inches and its length is 42 inches, therefore 314x42÷1,728=7.63 cubic feet per stroke.

Another way to calculate the contents is to multiply the number of cubic feet to the point of cut off, by the denominator of the fraction used to designate the point of cut off as a part of the whole stroke. In this case it is 1-5, therefore 1.526x5=7.63 cubic feet per stroke as before.

This means 73,248 per hour at 27 pounds pressure, as this is the absolute terminal pressure shown by this diagram, and its weight is .0673 pound per cubic foot. This accounts for 73,248x.0673=4,929.59 pounds per hour.

As the engine develops 279 horse power the indicator accounts for 4,929.59÷279=17.66 pounds per horse power per hour. If we add 30 per cent. for leakage, condensation, etc., it makes a total of 22.95 pounds per horse power per hour.

This is probably right for this engine, although it is a good record for a non-condensing engine. The high pressure and economical point of cut-off are in its favor.

The rule which determines the water used by taking the pressure at release seems to be the best, because it takes account of any steam that may leak in after the cut-off valve closes, still it does not show the water wasted by a leaky exhaust valve. We have omitted the clearance in this illustration.—W.H. Wakeman, in the Tradesman.

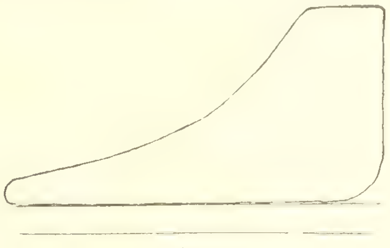


Fig. 2.

NOTICE.

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HAMILTON ASSOCIATION STATIONARY ENGINEERS.

An open meeting of Hamilton Association of Stationary Engineers was held in the Sons of England Hall early in February, which was well attended. Mr. Thos. Elliott, the chairman, after a few preliminary remarks, introduced Mr. Geo. Chantler, who gave a very interesting address on "Combustion of Fuel".

The subject, the speaker said, had occupied his attention almost twenty years, and as the result of his investigation, he had made a departure from the principles as taught in Schools of Science to-day. He then defined the elements in combustion.

The atmosphere is the great fuel supply of the world. One pound of carbon requires two and two-thirds pounds of oxygen to form combustion. The atmosphere is said to be a mixture of three elements. The speaker thought that air is a compound, just as water is a compound, as the proportions of the three elements are always the same, and are held in combination by fixed laws.

In this compound there are two elements that perform important functions, the oxygen unites with the coal and produces heat, but the heat generated is in the ratio of the amount of oxygen consumed. Nitrogen, under certain conditions, is combustible. With hydrogen it will produce combustion, and the result will be water. The water will be slightly acid, showing that the nitrogen has entered into the compound, this showing that nitrogen is combustible. In order to produce combustion it is necessary to bring these elements together under certain conditions. Elements such as those above mentioned show evidence of heat by color. At from 1200° to 1400° the color changes to a cherry red. It assumes a deep cherry red at from 1600° to 1800°. At 1900° it assumes an orange shade, and at 2000° white heat; at 2500° it is dazzling. The color indicates the temperature of the fire. To produce combustion at least 1000° are required, at 1400° combustion is more rapid, at 1600° it is quite rapid, and so on increasing as the temperature increases.

Nitrogen might be called the stoker, it enters into the fire in combination with the oxygen, and when these two elements come in contact with the heated carbon or hydrogen they are separated at the place where combustion takes place. Nitrogen is not only the stoker that carries the oxygen, but it is a great absorbent of heat, and also conveys that heat to the surrounding bodies and carries it to the point at which it is to be utilized.

The analysis of coal shows that it contains about 85 per cent. carbon and 5 per cent. hydrogen; of the carbon about 35 per cent. is free carbon. This free carbon and hydrogen when heated pass off through the chimney as smoke. If this can be burned, a great saving of fuel will be the result. Just along the front edge of the fire you have the flame of combustion, over your fire bed the flame of incandescent gas, and no combustion can take place at this point because there is no oxygen and also because carbon dioxide is present. Carbon dioxide will distinguish fire, and you cannot support combustion in the absence of oxygen. If this carbon dioxide can be eliminated, and a supply of oxygen supplied, then this smoke can be burned, and a great saving of fuel, as has been said before, will be the result. Then to burn coal to the best advantage, it is necessary to bring it in contact with two supplies of oxygen, and these must be distributed properly over the fire bed. The point is this, adjust your plans so that you bring heat and air together to consume the gas as it is liberated, and then bring another supply to burn your coke. The conclusion is that to burn soft or hard coal, burn it from the top, with a top draft, and in this way you can retain it and transmit it to the point where it is to be utilized.

At the conclusion of the address it was moved by Mr. R. C. Pettigrew, and seconded by Mr. W. Sweet, and unanimously carried that the thanks of the meeting be extended to Mr. Chantler for his valuable contribution.

THE ECLIPSE GASOLINE ENGINE.

Our readers will note the advertisement of D. McKenzie & Company, of London, Ont., on another page of this issue. This company's works at 298 Richmond street are now turning out stationary, marine and automobile gas and gasoline engines.

With a keen appreciation of the necessities of the market they have designed the Eclipse engine, and offer it as their result of many years' experience in gas engine construction. Great simplicity is the characteristic of the engine.

The governor is the well known Eclipse throttling type, and has been used with marked success for the most exacting service, and on engines used for driving dynamos for incandescent lighting. The speed of the engine may be quickly changed to any speed, or intermediate speed, from 100 to 800 revolutions per minute, by simply moving a small screw on the governor while the engine is running. The crank shaft is the best grade of steel, the throw being turned from solid metal, which adds to the strength of the crank. The igniter, which is an important part of any gas engine, is of the improved Eclipse electric tpye and it is claimed works perfectly in all kinds of weather.

A new switch-board will be installed this year by the Corporation of New Westminster, B.C., and later in the year it will probably be found necessary to make further additions to the electric plant.

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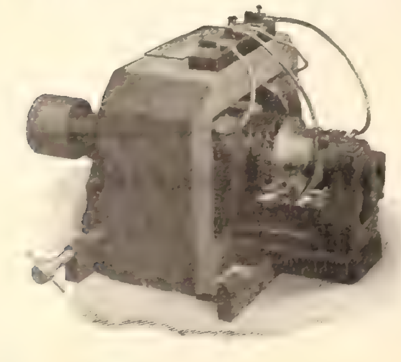

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SPARKS.

The Canadian Casualty & Boiler Insurance Company has been incorporated with power to carry on business in Ontario. Special attention will be given to insurance of boilers. Mr. A. C. C. Dinnick is manager of the company.

Mr. H. B. McGiverin, of Ottawa, has made application to Parliament for a charter for a steam or electric railway to be constructed between Toronto and Hamilton. The names of those behind the scheme have not been announced.

Parry Sound, Ont., has a municipal electric light plant, recently purchased from a private company. The result of the first year's operations has not been very satisfactory, as according to a correspondent of the North Star, a deficit is shown of $1,621.58. The expenses were $7,694.84 and the revenue $6,073.26.

Owing to a technical flaw in the by-law passed by the town of Berlin authorizing the purchase of the gas and electric light systems, the purchase money cannnt be paid over for the period of three months. Meanwhile the council are trying to arrange with the present owners to allow the works to be taken over and operated at once by the municipality, which will probably be agreed to provided proper guarantees are furnished.

MOONLIGHT SCHEDULE FOR APRIL.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Apr. 1	7 00	Apr. 2	5 00	10 00
2	7 00	3	5 00	10 00
3	7 00	4	5 00	10 00
4	7 00	5	5 00	10 00
6	0 00	6	5 00	5 00
7	0 40	7	5 00	4 20
8	1 20	8	5 00	3 40
9	2 00	9	5 00	3 00
10	No Light	10	No Light	
11	"	11	"	
12	"	12	"	
13	7 10	13	10 00	2 50
14	7 10	14	11 00	3 50
15	7 10	15	11 50	4 40
16	7 10	17	0 40	5 30
17	7 10	18	1 30	6 20
18	7 10	19	2 10	7 00
19	7 15	20	2 50	7 35
20	7 15	21	3 20	8 05
21	7 15	22	4 00	8 45
22	7 15	23	4 15	9 00
23	7 15	24	4 15	9 00
24	7 15	25	4 15	9 00
25	7 15	26	4 15	9 00
26	7 20	27	4 15	8 55
27	7 20	28	4 15	8 55
28	7 20	29	4 15	8 55
29	7 20	30	4 15	8 55
30	7 20	May 1	4 15	8 55
		Total	....	191 10

The citizens of Tweed, Ont., are considering the prospects for establishing an electric light plant.

Roderick J. Parke, electrical engineer, of Toronto, has been authorized by the Dominion Government to prepare plans for introducing electricity on the Welland Canal. It is proposed to light and operate the canal electrically, but the lighting only will be installed during the coming summer.

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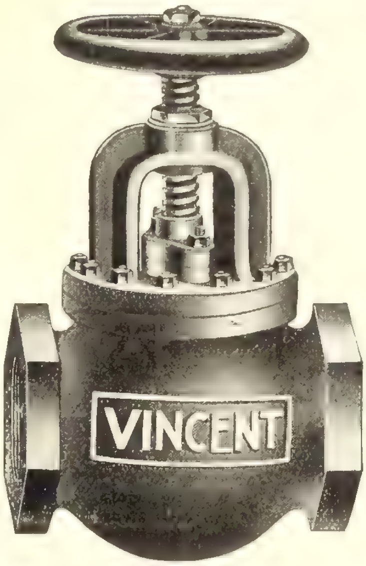

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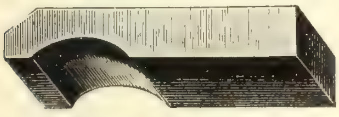
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TRADE NOTES.

The Hamilton Motor Works, Hamilton, are so busy with orders that they are installing a lot more machinery and a much larger power plant to enable them to keep up with their work. They are also taking on more hands and look for a very busy year.

The Nernst Lamp Company, of Pittsburgh, having secured patent and selling rights in Canada, is now making arrangements for establishing a factory in the Dominion for the manufacture of their product. This move is not only necessary in order to conform with the Canadian laws of commerce, but is also advisable in order to meet the rapidly increasing demands for this lamp.

The Pittsburgh Transformer Company, whose product is marketed in Canada by the R. E. T. Pringle Company, Limited, Montreal, is distributing an unusually interesting booklet on their transformers. The cover design of this publication consists of a photographic view of the city of Pittsburgh surrounded by a border in grey. The view of the city just mentioned is printed in three colors and is a remarkably handsome specimen of three-color work. Although small, it is surprising with what distinctness the details of the view are brought out. Pittsburgh lies upon a point of land between the Monongahela and the Allegheny rivers, which converge to and from the Ohio river. On account of the fact that there is probably no other city in the United States which has occupied such a large share of public attention during the last two years as Pittsburgh has, no doubt the illustration which the Pittsburgh Transformer Company has thus made use of will be of considerable interest.

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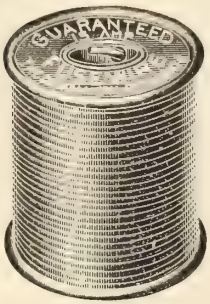

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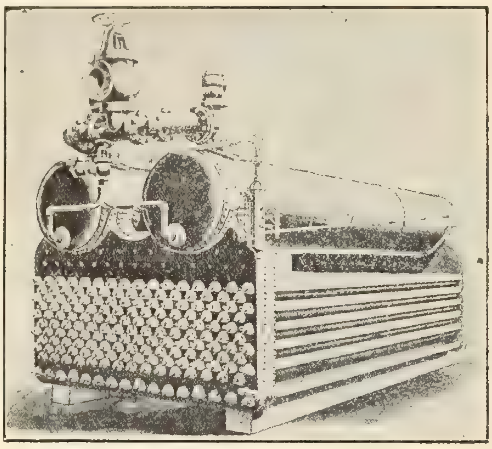

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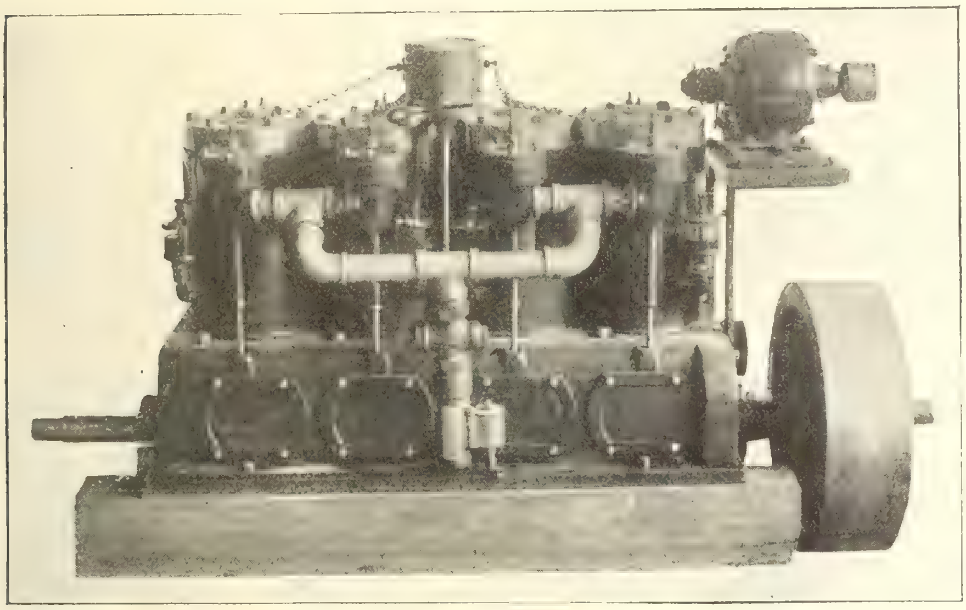

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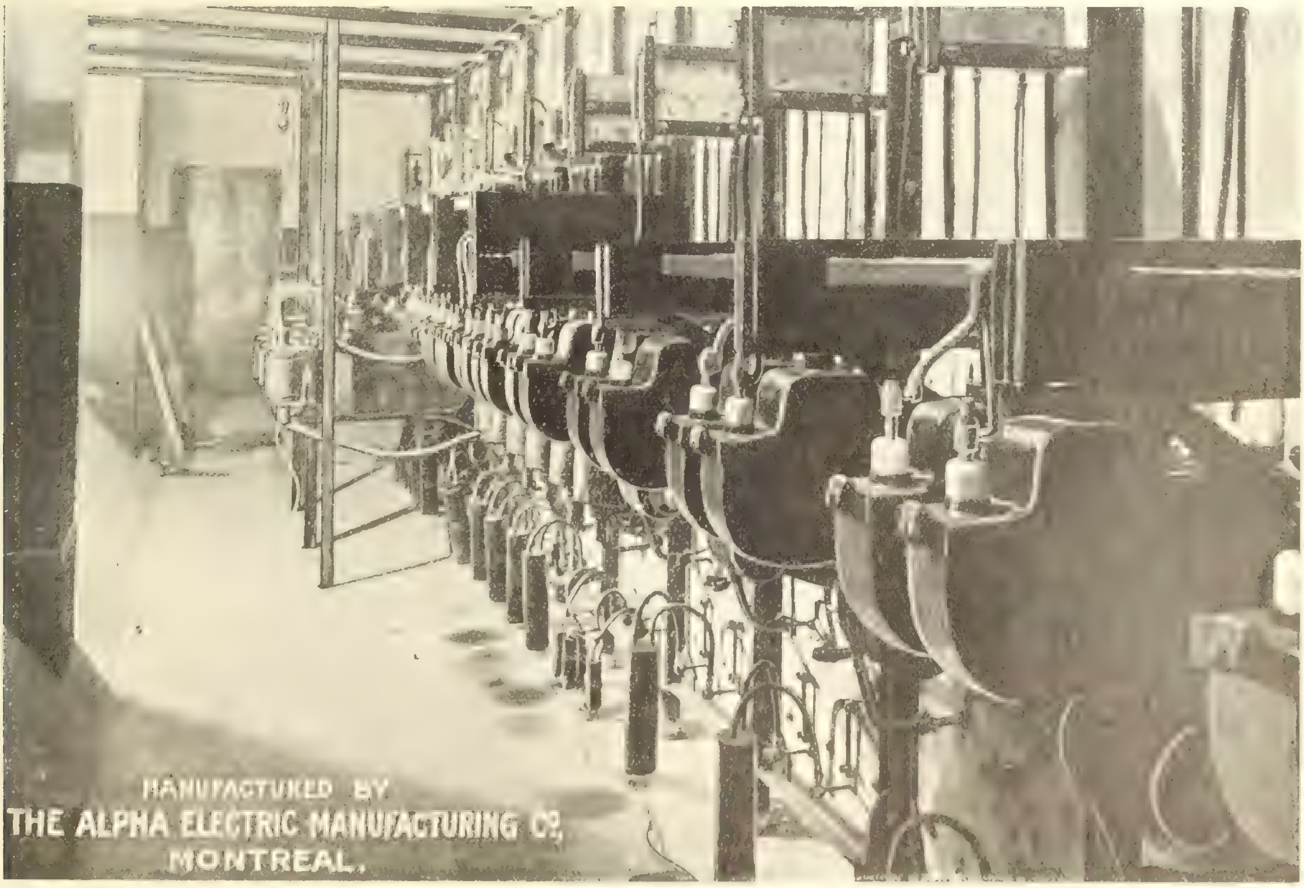

Front view of this Switch-board can be seen in the Canadian Engineer.

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MONTREAL.

SPARKS.

The Georgetown Electric Light Company intends adopting a new type of arc lamp.

The Council of Yarmouth, N.S., has decided to take steps immediately to install an electric light plant.

Mr. R. C. McLeay, proprietor of the electric light plant at Watford, Ont., is considering the installation of new apparatus.

The Middlesex & Elgin International Electric Railway Company has been granted a fifty-year franchise to operate a railway through Yarmouth township in Elgin county.

It is reported that James J. Hill, the American railway magnate, has purchased a large water power at Grand Metis, Que., and that it will be utilized in connection with an extensive scheme of electric railways and electric lighting.

The employees of the Toronto Electric Light Company held their first annual banquet in Webb's parlors on the evening of February 20th. Mr. William Bourne presided and about 150 employees and their friends partook of a sumptuous repast. The toast of "Our Guests" was responded to by the manager, Mr. J. J. Wright, and Mr. W. A. Martin, and that of "The Operative Department" by Messrs. Charles Moseley, H. Amos, Thomas Wright and H. Terry.

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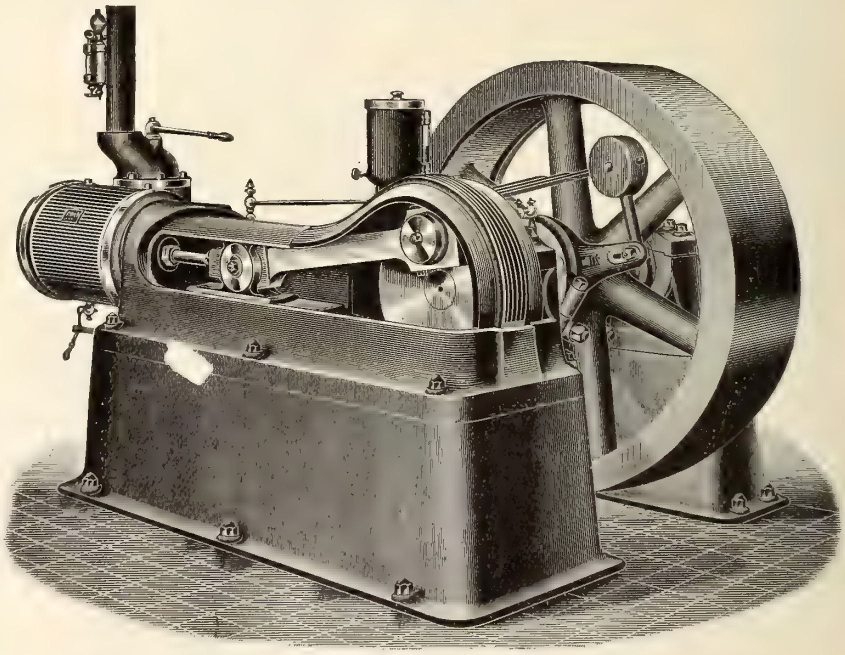

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SPARKS.

The boiler shop now being built in connection with the C.P.R. shops in Montreal will be 440 feet square and will cost in the neighborhood of $110,000.

The electrical equipment of the Cornwal Canal has just been completed, where thirty-three of the Ampere Electric Mfg. Company's induction motors were installed, most of which were in operation before closing of navigation last season.

The electric light plant at Mount Forest, Ont., is owned by the town. There are 15 arc lights of 2,000 nominal candle power supplied by a Ball generator, and 1,500 incandescent lights of 15 c.p. each. A 140 h.p. Wheelock engine furnishes the power. The installation of a larger dynamo in the near future is contemplated.

The United Railway Company, of Detroit, Mich., has nearly completed a line from Windsor to Amherstburg, Ont. The company bought the right of way from the property owners adjacent to the highway, so that the roadbed is not in the highway proper, as in most cases. Seventy-pound steel rails made in Sault Ste. Marie, Ont., are being used. All bridges are of steel and the cars will be of the latest suburban pattern. The road follows the bank of the Detroit River all the way from Sandwich to Amherstburg, a distance of 15 miles. It passes through a rich and thickly settled territory. Amherstburg has already become a favorite summer resort.

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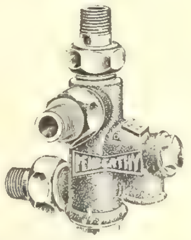

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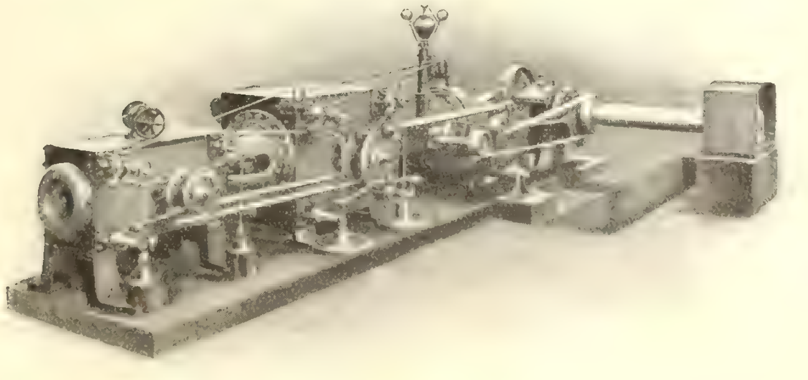

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SPARKS.

The Van Electric Company, electrical supplies, Brantford, Ont., is reported to have assigned to J. H. Gouch.

The ratepayers of Berlin, Ont., have voted in favor of taking over the electric light and gas plants at a valuation of $100,000. The majority was 532.

The London, Parkhill & Grand Bend Electric Railway Company is asking incorporation, to build an electric railway from London to Grand Bend via Parkhill.

The town council of Fort William, Ont., recently issued an injunction restraining the Bell Telephone Company from further extending their system within the limits of the corporation.

The Rothesay Water & Improvement Company, of Rothesay, N.B., has secured water rights and will erect an electric power station at Rothesay. Hon. William Pugsley is president of the company.

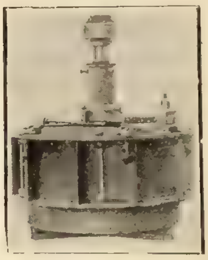
Mr. D. W. Ackerman has obtained water power privileges at the mouth of the Severn river and is organizing a company to develop electric power. It is proposed to develop ultimately 5,000 horse power and to transmit to Midland, Waubaushene, Coldwater and other places.

The Dominion Government has placed the order for electrical equipment of the Lachine Canal with the R. E. T. Pringle Company, sales agents for the Ampere Electric Mfg. Company, Montreal. Forty-nine motors are to be used in operating the lock gates and swing bridges.

The People's Light and Power Company, of Fredericton, N. B., has applied for incorporation to supply electric light and power to the city and suburbs. The applicants and promoters are Messrs. Wm. F. Chesnut, Albert W. Edgecombe, John S. Scott, Gilmore Brown and J. J. Fraser Winslow. The capital stock is $80,000.

An important scientific discovery is reported to have been made at McGill University, Montreal, the result of the joint experiments of Dr. Howard Barnes and Prof. Tory. It consists of remarkable electrical effects on metal surfaces due to dissolved air. The discovery is claimed to be new in the realms of science and to open up an immense field for interesting research work.

The Canadian Turbine



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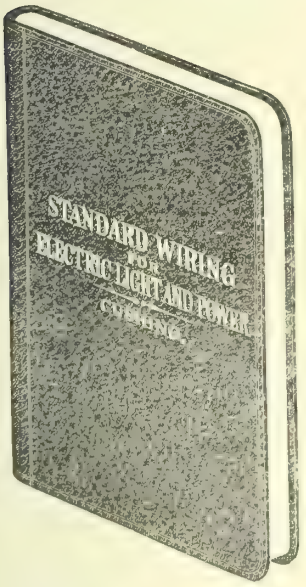
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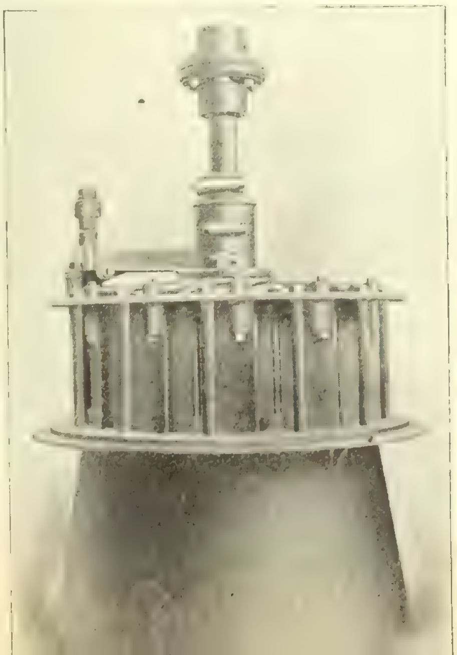
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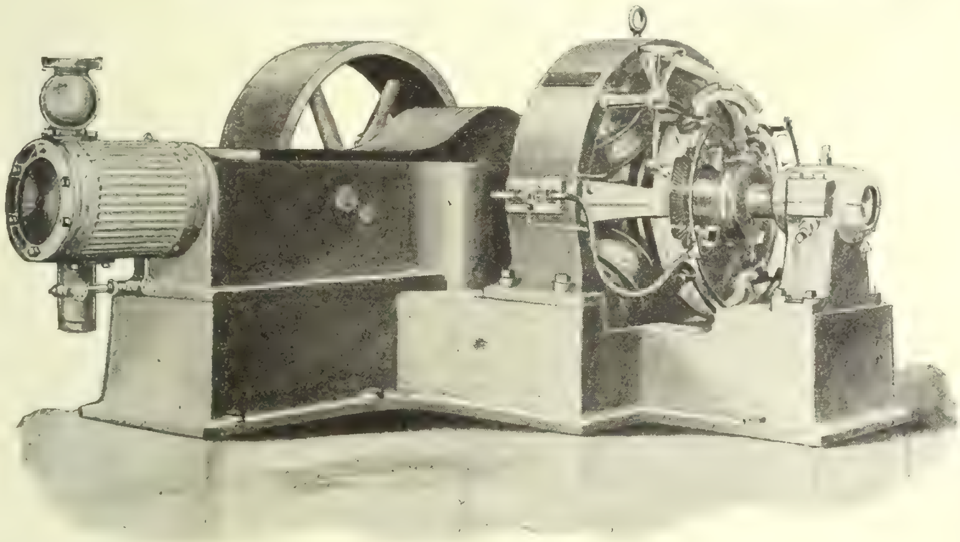

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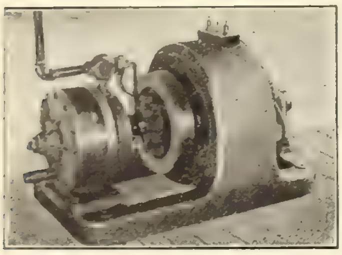

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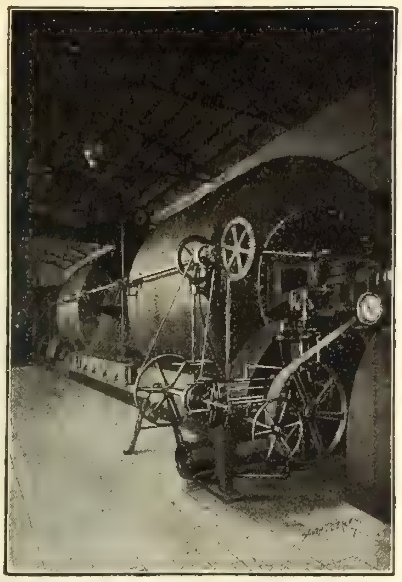

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Again congratulating you on the safes you turn out and trusting we will have the pleasure of purchasing from you when we again rebuild, as we know of none better, we are,

Yours truly,
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SPARKS.

The Aetna Boiler Insurance & Inspection Company has been incorporated by the Quebec Legislature.

The Town Council of Yarmouth, N. S., have decided to install a larger generator and 81 new enclosed arc lamps.

It has been decided to adopt the non-interference box system of fire alarm for the corporation of North Sydney, N.S.

The Nesbitt Electric Company, of Victoria, B. C., are installing a new marble switch-board in the Victoria Theatre in that city.

The town of Annapolis Royal, N. S., has been given power to borrow money for the purpose of completing the electric light plant.

The ratepayers of St. Mary's Ont., will vote on a by-law on April 17th to raise $6,000 for waterworks and electric light extensions.

The City Engineer of Winnipeg, Man., has been requested to report on the cost of installing a municipal electric plant for light and power.

The next annual convention of the American Institute of Electrical Engineers will be held at Niagara Falls, N. Y., June 29th to July 3rd of this year.

Messrs. Sutcliffe & Muir, who intend erecting a flour mill at Moosomin, N.W.T., have in contemplation the installation of an electric light plant for lighting the village.

The Cascade Water Power and Light Company, of Cascade, B. C., have made arrangements to light the village of Greenwood, for which purpose the transmission line from the power house to the town is now being constructed.

It is reported to be the intention of the Montreal Light, Heat and Power Company to develop the Soulanges canal power, which was recently purchased by that corporation from Mr. M. P. Davis. The power house will be located near the Ottawa river, and there will be constructed a channel about two miles in length. It is understood that no contracts for the work have yet been awarded.

The Lincoln Electric Light & Power Company, of St. Catharines, Ont., have made a proposition to supply electric light and power to Port Colborne. The price named is understood to be about $20 per h. p. per year.

The Cataract Power Company, of Hamilton, are building a new sub-station on Victoria avenue, north of Barton street, in which the step-down transformers will be installed. The equipment will include also four boilers each of 500 horse power, manufactured by the Sterling Company, of Chicago, and two Goldie & McCulloch engines of 1,500 horse-power each. The engine shafts are 24 inches in diameter and weigh 15 tons each.

The Stuart Machinery Company, of Winnipeg, have recently installed the following plants :An electric light plant of 250 lights capacity for the Royal Crown Soap Company ; a 100 light plant for Robinson & McKenzie Lumber Company, Cranbrook ; two sixty light plants for the East Kootenay Lumber Company ; 30 h. p. motor for W. J. Boyd ; three motors for Gallagher's abbatoir, and a 15 h. p. motor for the Arctic Ice Company.

Milton, N. S., has recently installed a system of electric lighting, operated by water power. The following is the scale of prices, 16 candle-power, incandescent, all night service : Houses —1 light, $2.50 ; 2 lights, $5.00 ; 3 lights, $7.50 ; 4 lights, $9.50 ; 5 lights, $11.50 ; 6 lights, $13.50; 7 lights,$15.50 ; 8 lights, $17.00; 9 lights, $18.50 ; 10 lights, $20.00. All over ten lights, $1.50 each. Store lights same as house lights. Churches, halls and mills, $1.00 per light up to 20 lights. All above that number 75 cents per light.

Messrs. Hunter, Cooper & Company, of Winnipeg, representing the Anglo- American Power Company, of Chicago, have entered into an agreement with the town of Fort William, Ont., to develop the water power of the Kaministiquia river to the extent of 5,000 horse power. The company is to supply the town with 1,000 horse power as the first instalment at $15 per horse power. The town has the right to take additional power up to 10,000 horse power, as it may require,and to sell the power in quantities of five horse power or less ; $100,000 is to be deposited in the Bank of Montreal by the company.

DID YOU EVER STOP TO FIGURE

The Special Advantages Offered in the Dodge Special Dynamo Pulley?

This Special Dynamo Pulley has a powerful iron center with a hardwood rim.

It offers the best belt transmission surface, reduces belt tension and journal friction to a minimum; it is perfectly balanced, runs almost noiselessly and will not "fly to pieces".

For high speed and heavy service, no iron rimmed or other wood rimmed pulley ever surpassed it.

Adopted by electricians and manufacturers of generators the world over, is sufficient evidence of its merits.

We are prepared at all times to furnish designs and estimates for complete installations and our engineers are at your service in case you need advice on knotty power transmission problems.

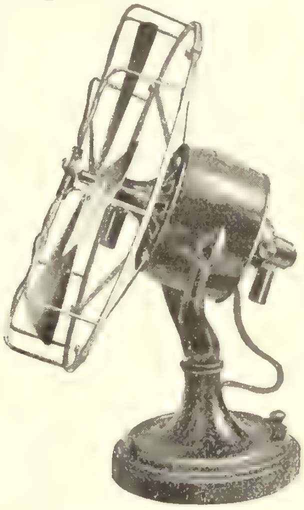
THE DODGE MFG. CO., OF TORONTO, LIMITED.

Westinghouse Fan Motors

Season 1903

For Alternating or Direct Current Circuits
Bracket or Desk Types.

High Starting Torque
Low Wattage
Variable Speed



The same motor may be used over a wide range of voltages.
Fan may be turned in any direction.

For particulars address

Ahearn & Soper Limited

Ottawa, Canada

Type "R"
Packard Transformers

The most economical and efficient transformer to be found in the Dominion is Type "R" Packard Transformer.

In submitting this statement we stand ready to demonstrate the superiority of this design, not only as to economy in operation, but as to durability as well.

The temperature rise in type "R" is remarkably low, its core loss wonderfully small, its regulation close, its efficiency remarkably high, its insulation, too, is well near perfect.

Long life—close regulation—high efficiency, are features of type "R".

Don't you think type "R" is worth investigation? Our preliminary bulletin will give you some valuable information.

We shall be pleased to send it to you.

THE PACKARD ELECTRIC COMPANY, LIMITED
ST. CATHARINES, ONT.

Eastern Offices, 42 St. Ry. Bldg., Montreal.

SPARKS.

Prince Albert, N. W. T., is installing an electric light plant.

Mr. Skinner is said to have abandoned the idea of installing an electric light plant at Atwood, Ont.

The citizens of Chilliwack, B.C., have decided to take immediate steps to install an electric light plant.

Mr. John Galt, C.E. & M.E., of Toronto, has been engaged to design an electric light plant for the corporation of Regina, N. W. T.

An expert will be engaged to value the electric and gas plants at Waterloo, of which the corporation proposes to assume control.

The new building for the Canadian General Electric Company at Halifax, N. S., is now nearing completion. It is modern in every respect.

A public meeting has been called at Durham, Ont., to discuss the installation of an electric light plant for street and commercial purposes.

The Toronto-Niagara Power Company have commenced work on the construction of the coffer-dam for the intake. The contractors are Messrs. Barry & McMordie.

Mr. A. E. Perkins, of Spark street, Ottawa, has designed a gasoline engine. It is an upright stationary engine and is said to be constructed upon distinctly original lines.

The Ontario & Quebec Power Company is seeking incorporation, to develop water powers on the Ottawa River. Messrs. T. Ahearn, Alexander Lumsden, Lev Crannell and Hon. E.H. Bronson are interested.

The New Brunswick Power & Pulp Company are seeking to acquire the powers and privileges given by the New Brunswick government to the Grand Falls Water Power and Boom Company, of Grand Falls, N. B.

The Raven Lake Cement Company are asking for tenders up to April 18th for the work only of constructing an electrical transmission line between Raven Lake and Elliott's Falls, Victoria County. The head office of the company is at 16 King street west, Toronto.

Mr. Hugh L. Cooper has been appointed resident engineer of the Mexican Light & Power Company, which is composed of Canadian capitalists, while Mr. F. S. Pearson has accepted the position of consulting engineer. These gentlemen have left for Mexico to begin work on the plant.

Mr. Frederic Nicholls, of Toronto, manager of the Canadian General Electric Company, has donated to the Dalhousie College at Halifax, Nova Scotia, valuable electrical apparatus for use in the chemical and physical laboratories, including a motor generator set and switch-board.

The light commissioners of Fort William, Ont., have accepted the following tenders for additional electric plant: Dynamos, Westinghouse Electric & Manufacturing Company, Pittsburg; arc lamps, Canadian General Electric Company, Toronto; engine and boilers, Goldie & McCulloch Company, Galt.

An examination for the purpose of giving holders of provisional certificates and apprentices an opportunity of qualifying as second and third-class engineers will be held by the Inspector of Steam Boilers at Edmonton, N. W. T., on April 14th and at Strathcona on April 18th. The inspector is Mr. Joseph Buxton.

The Toronto & Niagara Power Company, of which Mr. Frederic Nicholls is vice-president and general manager, are asking for tenders up to May 11th for the construction of the necessary tale race tunnel in connection with power development at Niagara Falls. The head office of the company is in the Home Life Building, Toronto.

The town council of Peterboro, Ont., have under consideration a proposition for the revival of the dormant street railway. The American Cereal Company, which owns the controlling interest in the Light & Power Company, which does the city's electric street lighting under contract at $65 per lamp, offers to amalgamate the Light Company with the Street Railway Company and operate the road. The situation is complicated, however, by the offer of the Otonabee Power Company to furnish street lights at $32 per lamp.

The real test is actual operation. When all has been said, the fact remains that a poor transformer cannot give a service free from burn-outs or other troubles.

Quebec-Jacques Cartier Electric Company.

QUEBEC, CAN., February 26th, 1903.

PITTSBURGH TRANSFORMER COMPANY,
PITTSBURGH, PA.

GENTLEMEN,—Replying to your enquiry of the 11th, we may say that we have somewhere in the neighborhood of 200 K.W. in Pittsburgh power transformers and about 900 K.W. in Pittsburgh lighting transformers, ranging from 1 K.W. to 15 K.W. units. On an average these transformers have been in use for three years. So far we have had four cases of burn-outs and there is only one case in which the cause could not be traced to either lightning or overload.

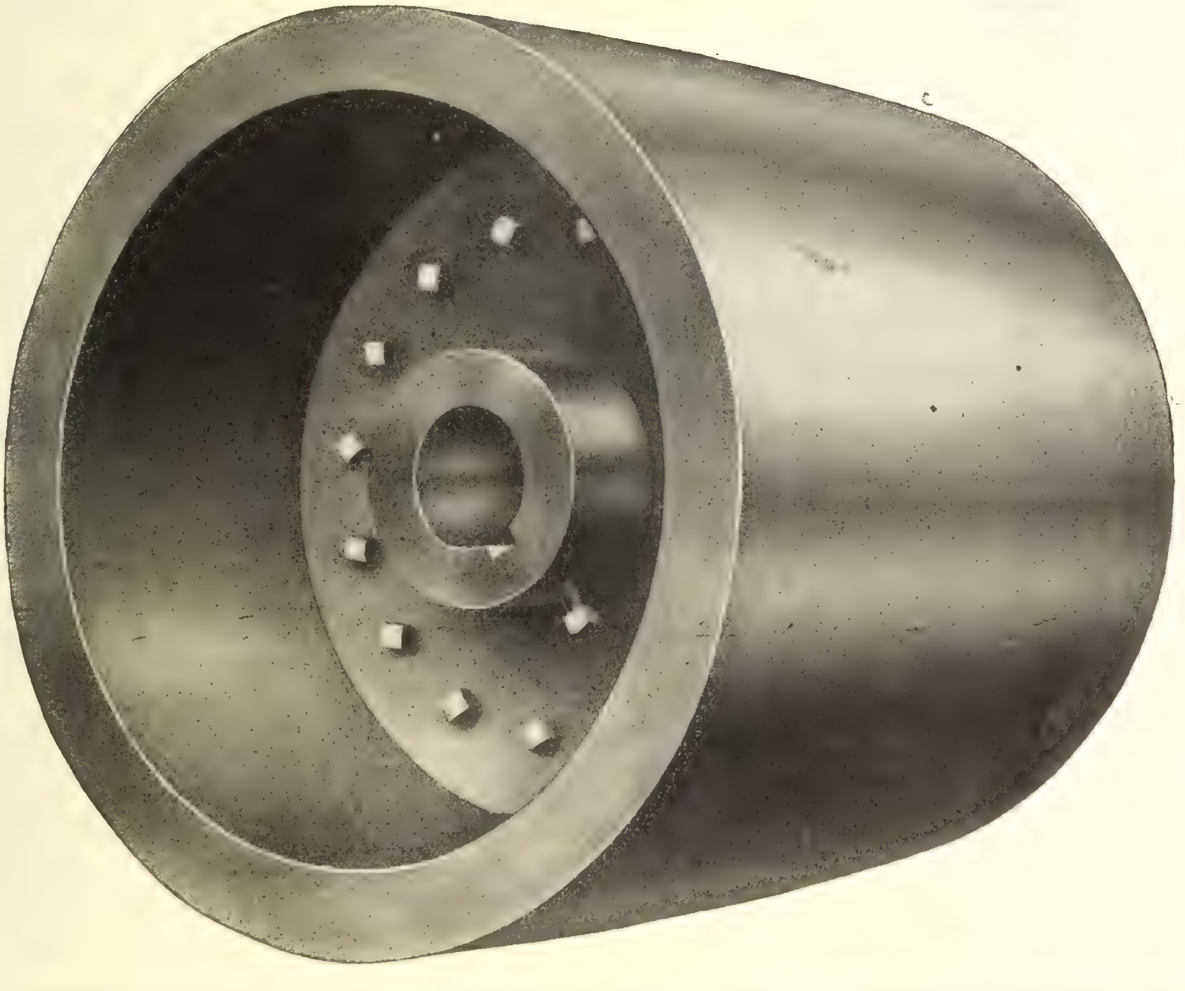
We take pleasure in saying that we consider the transformers have given us entire satisfaction up to date, and the careful test which each transformer has been subjected to before putting into service shows that the transformers are of a superior quality.

Yours very truly,
QUEBEC-JACQUES CARTIER ELECTRIC CO.
Edward Slade, General Manager.

The **R. E. T. Pringle Company, Limited.**
SALES AGENTS **172 Dalhousie Street, Montreal.**

Pittsburgh Transformers.

XYLOTITE PULLEYS



THE ABOVE PHOTOGRAPH WAS TAKEN FROM ONE OF A LOT OF OUR 52½x56x8 XYLOTITE PULLEYS, WHICH WERE THE LARGEST FIBRE PULLEYS EVER MANUFACTURED.

SPECIFY XYLOTITE PULLEYS ON ALL APPARATUS

WE MAKE ALL SIZES. NONE TOO LARGE OR NONE TOO SMALL.

THE XYLOTITE MFG. CO.

CINCINNATI, OHIO

SPRAGUE ELECTRIC CO.

INTERIOR CONDUIT

Iron Armoured Flexible Metallic
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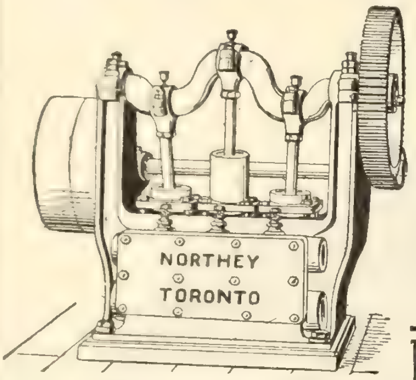
Armoured Flexibie Interior Cables.

Watson Jack & Co., Montreal.

THE NORTHEY TRIPLEX POWER PUMP

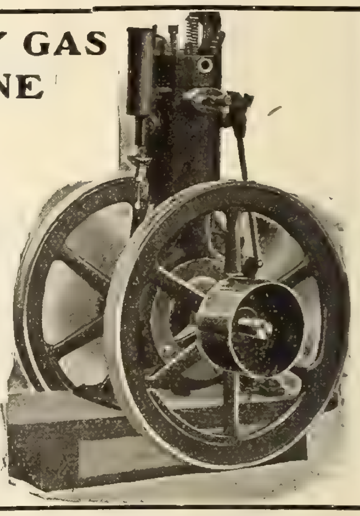


This pump excels in high class materials and workmanship. A practically constant delivery is assured by the three cranks being placed 120 degrees apart. The pump can be operated conveniently by water power—by belt from engine or by electricity.

We manufacture pumps of every description—for all purposes. Our pumps are standard in Canada for excellent service.

Write for Catalogues.

The NORTHEY GAS AND GASOLINE ENGINE



The Northey Gasoline Engine offers the best proposition in the market for cheap, easily handled power. The Engine runs with practically no attention—any boy can manage it—running expenses very light. Ready for work on the minute. Suitable for running independent electric light plants—pumping and elevator plants, etc. This cut illustrates the ½ H. P. size—the only vertical style built; all other sizes are horizontal.

Write for Booklet.

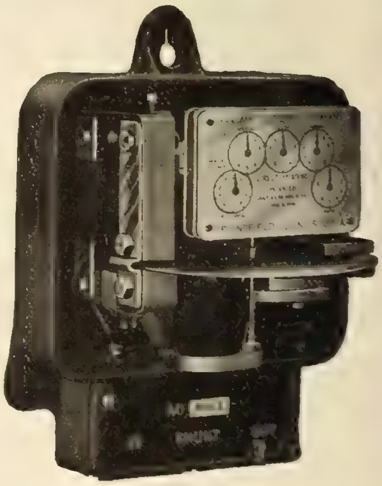
THE NORTHEY CO., LIMITED, 970 King Street Subway TORONTO.

NEW GUTTMANN WATT METER

FOR ALTERNATING CURRENTS

IN SHORT

- The New Meter is of the sealed type.
- Is correct on all loads from two per cent. of its capacity to fifty per cent. overload.
- Internal losses are practically nothing.
- Accuracy maintained.
- Simplicity in design.
- Firmly constructed.
- Dust, insect, moisture and water proof.
- Extremely light weight (10 lbs.)
- Pleasing in appearance.
- Reads directly in watt hours.
- Easily installed.
- No complicated parts.
- No friction.



JOHN FORMAN

708 and 710 Craig Street
MONTREAL

BOILER FEED WATER PURIFYING SYSTEM

FILTERS
PUMPS
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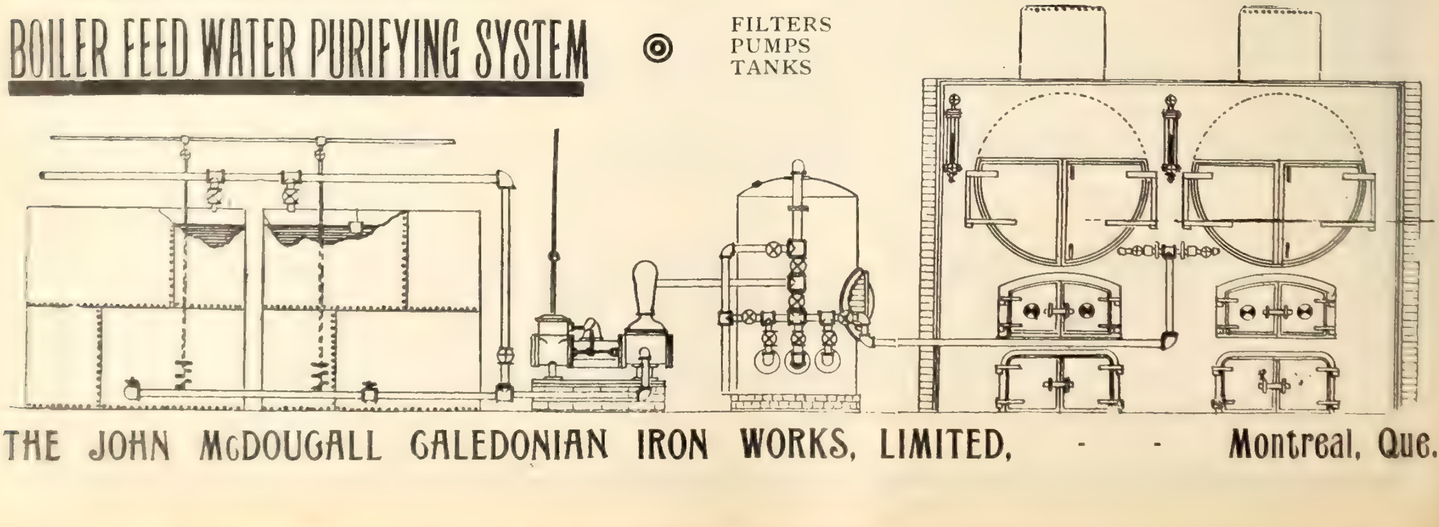


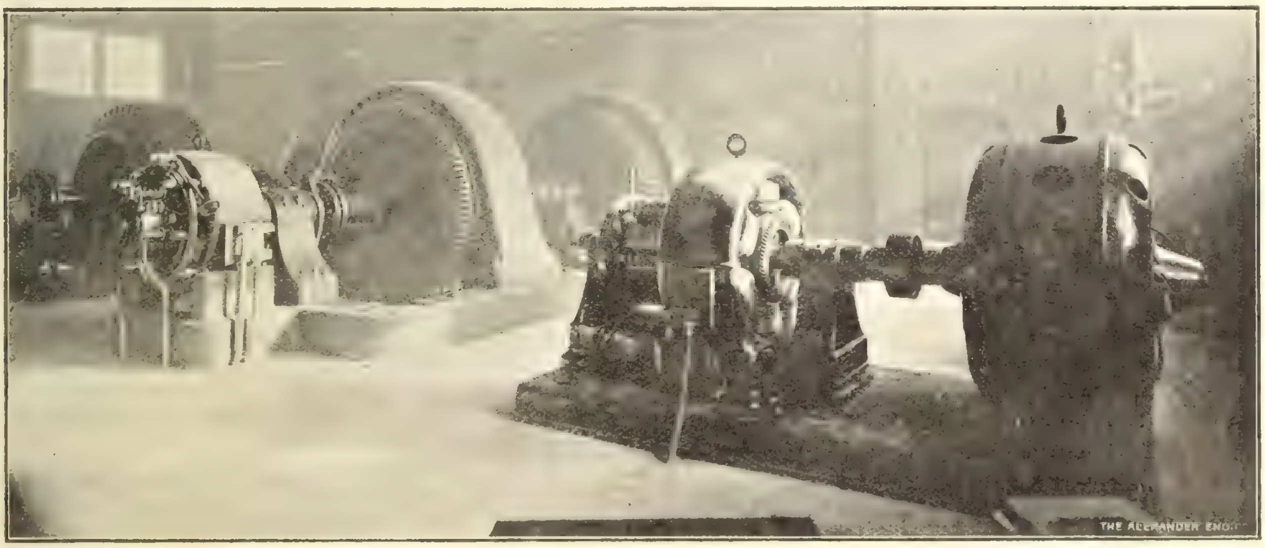
THE JOHN McDOUGALL CALEDONIAN IRON WORKS, LIMITED, - - Montreal, Que.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. APRIL, 1903 No. 4.

THE TRANSMISSION LINE AND TERMINAL STATION OF THE SHAWINIGAN WATER AND POWER COMPANY.

In respect to distance and voltage the electric transmission system of the Shawinigan Water & Power Company, which has recently been put into operation, is the most important in Canada. The current is transmitted from Shawinigan Falls to Montreal, a distance of almost eighty-five miles, at a pressure of 50,000 volts. As it is hoped to publish at a later date a comprehensive description of this plant, brief mention only will here be made of the water power development and generating apparatus. The source of supply is the Shawinigan Falls, on the St. Maurice River, where the peculiar formation of land permitted of a remarkably cheap development. A canal 850 feet long, 100 feet wide, and 40 feet deep, diverts a volume of water sufficient to produce 75,000 horse power.



Frequency Changers and Motor Generator Sets in Terminal Station of Shawinigan Water & Power Company, Montreal.

The water wheels have a capacity of 6,000 horse power under a head of 125 feet, and were made by the I. P. Morris Company, of Philadelphia. The generators are of the Westinghouse A. C., two phase, 2,200 volt, rotating field type of a capacity of 3,750 k. w. The current is converted into three phase and by means of step-up transformers is raised to 50,000 volts for transmission, the frequency being 30 cycles.

THE TRANSMISSION LINE.

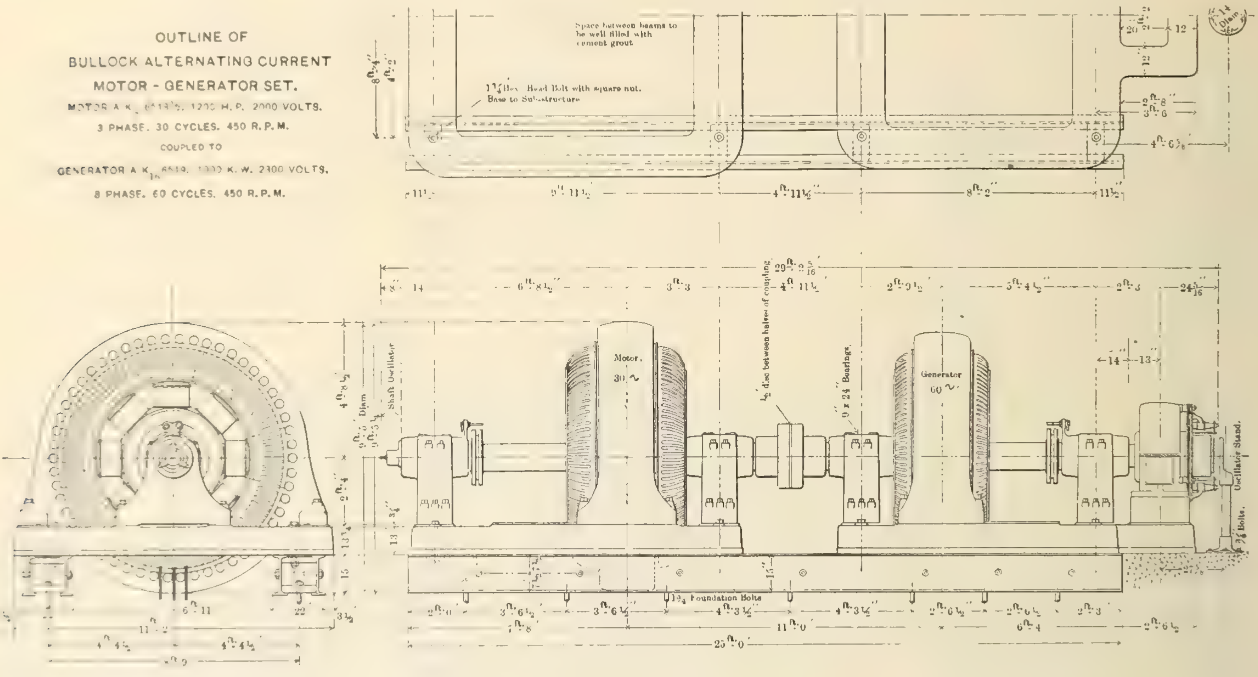
The transmission line is 84 3-10 miles long, measured from the generating station at Shawinigan to the terminal, or distributing station, in Maisonneuve, a suburb of Montreal. After running across open country for a distance of four and a half miles from the power station, the line comes out upon the Great Northern Railway of Canada, and from this point it runs westward through a number of villages and towns, until it reaches the important manufacturing town of Joliette, a distance of 45 miles. From Joliette to Montreal the line follows the right of way of the Joliette-Montreal branch of the Great Northern Railway to the village of Charlemagne, on the bank of the Ottawa river, opposite the Island of Montreal. After crossing the river the line follows the course of the Montreal Terminal Railway until it reaches the terminal or distributing station in Maisonneuve. For eighty miles of its length the line parallels the railway at a uniform distance of 43 feet.

The line consists of approximately 4,500 cedar poles, 10 inches in diameter at the base and 7 inches at the top, witn a minimum length of 35 feet, the poles being set six feet in the earth, and in line at a distance of 100 feet apart. The cross-arms are of Georgia pine 4¾ inches square and 6 feet long, treated in liquid asphalt. On three pins 2½ inches in diameter and 18 inches long are mounted white porcelain insulators. There are approximately 14,000 insulators, each weighing fifteen pounds, which have been tested to over 100,000 volts.

Each of the three transmission cables is composed of seven strands of No. 6 B. & S. gauge aluminum wire, one strand forming a straight core, around which are twisted the remaining six wires. The diameter of the cable is one-half inch, and it weighs a trifle over 2⅔ ounces per lineal foot. As there are seven wires in each of the three cables, it follows that 1,771 miles of aluminum wire were used on the entire line, and that the total weight of wire used on the entire line was over 250,000 lbs. The two lower cables throughout the transmission line run at an approximate height of 20 feet from the ground. The ends of each length of cable are joined by means of the "McIntyre" sleeve joint, an oval aluminum tube, with inside diameter of ½ x 1 inch and a length of 9 inches. The junction is effected by slipping the ends of the cables inside the oval tube, and then twisting the tube, thus by friction firmly binding together the two lengths of the cable.

THE TERMINAL STATION.

As the Shawinigan Company could not enter the city of Montreal without permission of the council, a transforming station was built in Maisonneuve on the outskirts, where the current is by arrangement handed over to and distributed by the Lachine Rapids Hydraulic & Land Company, which has recently been absorbed by the Montreal Light, Heat and Power Company. This terminal station is built of brick in the form of an oblong square, the dimensions being about 95 feet x 115 feet. The trusses are of steel, the roof and floors of concrete and steel. The station is divided into two unequal parts by a heavy brick wall running lengthwise throughout the building. The Lachine Company occupies a specially constructed wing of the building, where is located the switchboard, etc., largely of Westinghouse manufacture. In the smaller division are the step-down transformers of the static or stationary type, with a working capacity of 2,800 horse power each. The transformers, encased in cylindrical tanks 15 feet high and 7½ feet in diameter, are surrounded by oil, each tank holding 750 gallons. The pressure of 50,000 volts, at which the current is transmitted from Shawinigan Falls to Montreal, is reduced to 2,200 volts to conform with the voltage used by the Lachine Company.


OUTLINE OF
BULLOCK ALTERNATING CURRENT
MOTOR - GENERATOR SET.
MOTOR A K 6513½. 1200 H.P. 2000 VOLTS.
3 PHASE. 30 CYCLES. 450 R.P.M.
COUPLED TO
GENERATOR A K 6519. 1000 K.W. 2300 VOLTS.
8 PHASE. 60 CYCLES. 450 R.P.M.
Space between beams to be well filled with cement grout
Head Bolt with square nut. Base to Substructure
Motor. 30 ~
Generator 60 ~
Shaft Oscillator
Oscillator Stand.
Foundation Bolts
25 ft. 0
Bearings

Dimensions of Frequency Changers, Shawinigan Water and Power Company.

At a distance of fourteen miles from Montreal, the line is carried across the Ottawa River, but as the construction of the Great Northern Railway bridge (over which it was originally intended the line should be carried) was not far advanced, it became necessary to erect a temporary line and advantage was taken of the presence of an island in midstream, which made possible the crossing of the river by two spans. Each stretch of the river's width is now spanned by three 1-inch steel cables, which are supported on four towers, each 90 feet high. The cables have a tensile strength of 125 pounds per square inch ; the spans are 1,200 and 1,850 feet long respectively. Under the present arrangement, the current on arrival at Charlemagne is transferred from the aluminum to the steel cables ; through the latter it crosses the river, and at the other side passes from the steel to the aluminum cables. The insulators placed on the towers for the support of the steel cables were made to sustain the enormous strain of the cables as well as to serve as insulators—they are very costly, and were specially prepared only after the most careful calculations and tests had been made. Upon the completion of the railroad bridge across the Ottawa River, aluminum cables will be strung across that structure, and the steel cables now spanning the river will be retired from use.

The main division of the station is occupied by the frequency changers and motor generator sets, manufactured and installed by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, and shown on the previous page. At present there are installed only two frequency changers, each of 800 k.w. normal output, but capable of developing 1000 k.w. Two more sets identical with those installed are in process of manufacture and nearly completed. Attention might here be drawn to the method of placing these machines upon a solid foundation. In view of their great length and weight it was deemed advisable to use "I" beams for the sub-bases, the beams being filled in solidly with concrete.

One of the main features is the unique yet simple method of starting the frequency changers or motor generator sets. This is accomplished by means of a 100 h.p. 60 cycle 3-phase motor direct connected to an 85 k.w. 120 volt generator. In this station 60 cycle 3 phase is always available from the circuits of the Lachine Rapids Hydraulic & Land Company. The exciters on the frequency changers are used as motors in starting, the source of current coming from the motor generator set above referred to. As soon as the 30 cycle motor of the frequency changer is synchronized and thrown upon the circuit, the 60 cycle motor generator set is thrown out of circuit and the exciter of the large set runs as a generator, which excites the fields of both machines of the frequency changer. By means of throw-over switches this one small 60 cycle motor generator set will start any number of frequency changers.

The third illustration shows the dampers placed upon the fields of both generators and exciters, which insures speed being constant with either machine of the frequency changer operating as a motor ; thus, in case of any difficulty at Shawinigan the 60 cycle machine can be operated as a motor from Lachine Rapids current, delivering power at Shawinigan Falls.

SECTION OF ROTOR OF BULLOCK GENERATOR, SHOWNG DAMPERS.

SPEED REGULATION OF INDUCTION MOTORS.

The simple induction motor is essentially a constant-speed machine. This feature of its operation has many times been urged against its use for many applications.

Means of varying speed have been known, but while these were very effective they brought in objectionable features. Since the speed depends upon the frequency, it of course could be varied by variation in the frequency. This method, says the Electrical Review, is not generally applicable, requiring as it does as many generators as there are changes in speed. By using two motors and combining these in cascade or concatenation several speeds can be obtained, but the efficiency of the system is poor and the need for installing two motors is objectionable.

Where but two or three changes in speed are called for, these can be secured efficiently by winding the motors so as to allow for a change in the number of poles. The changes are in steps and not gradual.

The most generally applicable method of varying the speed of induction motors has been rheostatic control. By inducing non-inductive resistance into the secondary of the motors the speed can be varied at will and the available turning effort of the motor is not decreased. This method is unfortunately very inefficient, as the total energy absorbed by the rheostat is wasted and this varies proportionately to the reduction in speed. For intermittent work, however, and for starting motors under load, the method has found a wide use.

Recently a number of foreign papers have described a new means for securing this desirable speed variation without involving the objections pointed out above. If we reduce the current in the secondary by means of a counter-electromotive force instead of by the non-induction resistance just described, the speed of the motor can be reduced accordingly. At first thought there would seem to be considerable difficulty in doing this, since the frequency of the currents in the secondary is a variable quantity depending upon the slip, and is different from that of the currents in the primary. Nevertheless, this is not difficult to do. By adding a commutator to the secondary and properly placing brushes upon this, the counter-electromotive force may be suitably introduced. The most convenient way of doing this is to connect the brushes to the secondary of a suitable transformer, the primary of which is connected to the power circuit. By using any of the well-known types of regulating transformer, this counter-electromotive force may be varied in amount and in direction. If it opposes the flow of current in the secondary, the speed of the motor will be correspondingly reduced. If, on the other hand, this elecromotive force assists the flow of current the motor may be run above synchronism. In this method, the power which would be dissipated as heat in the rheostatic control is pumped back into the circuit, so that the efficiency of the system is lowered only by the transformer losses.

This arrangement is applicable with either the primary or the secondary as the revolving part. In addition to the speed regulation secured, this system enables one to compensate for the phase displacement of the primary current by the method described by Heyland and others. This is accomplished by shifting the position of the brushes on the commutator. One of the difficulties presented by this system is that of overcoming sparking, but doubtless this can be done.

It is worthy of note that the latest developments of the induction motor, namely, those of improving the power factor and securing variable speed, have been secured by adding a commutator. The absence of the commutator on induction motors has heretofore been urged as one of the chief advantages of this type of motor.

Boiler rivets should be carefully examined, according to a report of the Mutual Boiler Insurance Company, by the following cold tests : Driving them down on an anvil with the head in a die, by nicking and bending back on themselves without developing serious cracks In tests made by the company, steel rivets stood up well as a rule, but iron rivets did not and one brand of steel rivets proved very poor.

ALUMINUM AS A CONDUCTOR.

CLEVELAND, OHIO, March 13th, 1903.

Editor Electrical News

DEAR SIR :—I was very much interested in a clipping bearing on the subject of aluminum sent to me marked from the "January number of the CANADIAN ELECTRICAL NEWS."

Your correspondent states at the outset that while it was thought some time ago aluminum would be largely used as an electrical conductor, expierience has demonstrated that it is not held in favor and that it has not been adopted to any extent for the purpose mentioned. It seems to the writer that if your correspondent had taken sufficient interest in the subject in regard to which he put himself on paper to ascertain some facts the opinions which he now entertains would be materially altered.

Without going into an exhaustive digest covering the article I would state :—

First : Relative to the cross section and weight of aluminum as respects copper, that for equal conductivity, assuming aluminum 60 to 62 and copper 97 to 98 in the Mattheissen Standard Scale, the cross section of aluminum is 150, copper 100. Your correspondent has evidently calculated that the area of cross section of wires and their diameters bear the same relation to each other, which it is apparent is a slight mathematical error. Correctly calculated an aluminum wire having 1.59 cross section of copper will have a diameter only 1.26 of that of the copper, i.e. : 159 : 100 :: 126 :: 100.

The weight of aluminum having equal conductivity is 47.50 per cent. of that of copper. This arises from the fact that the specific gravity of copper is 8.93 and aluminum 2.68. The following proportion, therefore, gives the result above quoted, taking into consideration that the volume of aluminum is 1.59 times the volume of the copper :—

8.93 x 100 : 268 x 159 :: 100 : x

the solving for, x which is the aluminum weight when the copper weight is 100, we get x=47.5. In other words for equal conductivity on the basis of the foregoing data, 47.50 pounds of aluminum would be required to replace 100 pounds of copper.

Second : Your correspondent states that for small wires an alloy of 1 to 2 per cent. is used to produce strength. This is incorrect, as all wire for electrical conductor work as at present manufactured is of the same quality and is "pure aluminum." The breaking load of aluminum for equal conductivity with copper is as great, if not greater than copper.

Third : In connection with the matter of joints it is stated that aluminum cannot be soldered and what is known as the MacIntyre joint is used. Aluminum soldered joints are in successful service, but for greater strength of the joints, what is designated as a three piece compression joint is recommended for use where large wires are used, for the reason that greater strength and higher electrical efficiency is obtained with a joint of this character than with a soldered joint. A good mechanical or compression joint is in the opinion of some well informed engineers superior to any soldered joint. The reason is obvious, the strength of the former being greater than the latter.

Fourth : Your correspondent states that results are not obtainable respecting the varying climatic effects on aluminum on account of aluminum being installed practically exclusively in the state of California ; also that the action of the salt atmosphere has an injurious effect upon the metal. A portion of the above statement is in itself contradictory, because if aluminum was deteriorated by the salt air it would not be used in California or on the Pacific Coast. That aluminum is not injured by salt air action where it is installed on the Pacific Coast in close proximity to the salt water is demonstrated by the fact that millions of pounds have been in successful service for several years and those companies using it for the longest periods continue to purchase it in large quantities, the claim being made in some instances that it is superior to copper.

Relative to the absence of data outside of California, your correspondent is very much in the dark and is not informed. Aluminum is used in large quantities in the New England states, New York state, the middle states, the west and the far west for high tension and feeder railway work and for electric lighting purposes. Some of the largest syndicates and individual corporations in the territories mentioned have used aluminum conductors for a long time and continue to purchase it. While California purchases large quantities of aluminum wire and cables, other territories in the east and west purchase and use it in larger quantities and in those different localities data has been obtained under varying and trying conditions which has been most favorable to aluminum. A particular instance near enough and sufficiently prominent is the last transmission line of the Niagara Falls Power Company from Niagara Falls to Buffalo, consisting of three 500,000 c.m. aluminum cables and which should have been easily within the knowledge of your correspondent if he had really been ordinarily well informed in regard to what has been done in the transmission field and to have prevented his making one of the statements in the article alluded to. Another instance of which he should have been presumably aware is the line of the Shawinigan Falls Power Company from Shawinigan Falls to Montreal, which is entirely constructed of aluminum and will contain quarter of a million pounds of it.

It may be of interest to state that in Eastern New York during the recent extreme cold weather which prevailed about two months ago, in an aluminum high tension transmission line covering a large quantity of wire there was but one break in the system, while on a copper transmission line adjoining of equal conductivity and about an equal quantity of wire there were eight breaks. The showing in favor of aluminum is evident and is most satisfactory. Another instance in a different territory may be cited : A transmission company operating in Colorado, Utah and Montana has over 2,000 miles of aluminum wire in service, the circuits passing through the valleys and over the snow-clad mountains, where it is subjected to the extreme hot and cold temperatures. This company has had aluminum in service for a number of years and still continues to purchase it in large quantities. Yours truly,

J. A. RUTHERFORD.

ELECTRICALLY CONTROLLED WATER WHEEL GOVERNORS.

MONTREAL, March 23, 1903.

Editor CANADIAN ELECTRICAL NEWS :

DEAR SIR :—The writer noticed in the columns of your March issue the question on electrically controlled water wheel governors.

The Lachine Rapids Hydraulic & Land Company, of Montreal, use in their 12,000 h.p. water power plant a device on their Lombard water wheel governors by which the latter can be electrically controlled from the operating table. This very simple device consists of two solenoids, each of which actuates a ratchet wheel on the spindle of the governor. By operating either of the two solenoids the gates can be opened or closed. Each ratchet wheel has a large number of teeth, so that each time the circuit of the solenoid is closed, only a very small movement of the spindle takes place and consequently a very close adjustment of the speed is possible. It has been found possible to synchronize machines in one-tenth of the time previously required without this device. The device was invented and designed by R. S. Kelsch, general superintendent of the Lachine Rapids Hydraulic & Land Company. Mr. Kelsch also invented, a number of years ago, the motor control device, which your paper mentions, and communicated same to the Lombard Water Wheel Governor Company. In the design of the Lachine Rapids plant, Mr. Kelsch abandoned the idea of the motor control device on the ground that it gave the switchboard attendant too much latitude over the governor.

With reference to the subject of double busbar arrangement mentioned in the same issue by "Reader," I would draw "Reader's" attention to an article on the Lachine Rapids plants in the Canadian Engineer of June, 1901, which particularly describes the busbar arrangements at the power house and sub-station. It is always advisable for a large company, and even for small companies, to have a subdividable double busbar arrangement for its sub-station distribution busbars. The increase in expense over a single busbar arrangement is insignificant compared with the greater safety and better service obtainable thereby. For the transmission of the power to the sub-station, however, a double busbar arrangement is not absolutely necessary. Indeed, the modern practice nowadays is to simplify the power house switching devices as much as possible, and to do away with the double busbars. A single busbar equipment subdivided into three or four sections, tied together or seperated by switches operated by hand and automatically by overload devices, offers sufficient flexibility and all the safety desired. In designing the power house switchboards on this principle, Mr. Kelsch had in view the possibility of tieing the whole system together, or in the event of an accident to any portion of the system, it can be quickly separated from the rest of the system until repairs are completed. The arrangement of puttting the busbars in sections permits during light loads, or Sunday, etc., any portion of the plant to be made dead throughout, permitting any slight repairs that may be necessary and a general and thorough cleaning up of the busbars, marble, etc., without the slightest chance of injury to an emyloyee.

In the case of a double set of busbars, it is usually found necessary to have them comparatively close together, which does not make the system quite so safe and convenient. In the sub-station distribution system double busbars are essential, as it is frequently desired to have two ranges of voltages, one for the heavily loaded, the other for the lightly loaded feeders.

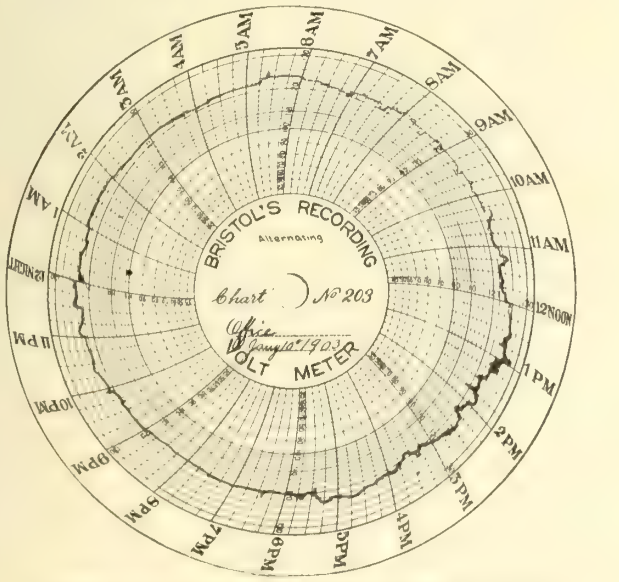
Yours truly,
CHARLES BRANDEIS.

POWER TRANSMISSION AND DISTRIBUTION IN UTAH.

For about three years the Utah Light and Power Company has been running three water power stations and two steam stations all in parallel, on its general distribution system. This has been done without any particular complications, and, as has been proven, with very great advantage in the economizing of the water available in the mountain streams. It is especially interesting, considering that the three water power stations generate and transmit at different voltages.

The Upper Cottonwood Station is equipped with General Electric apparatus, which generates and transmits 16 miles, three phase at 12,000 volts. The Lower Cottonwood Station, equipped with Westinghouse apparatus, generates two phase and transmits 14 miles, three phase at 14,000 volts. The Pioneer Station, situated 37 miles north, in Ogden Canyon, has General Electric machinery and transmits three phase at 16,000 volts. The two steam plants generate at 2,300 volts and feed into the general distribution system in Salt Lake.

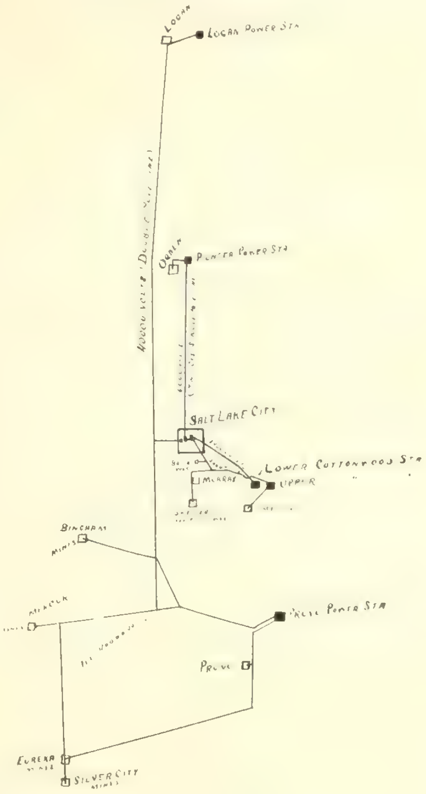
On December 30th, to this already large system, with its six stepdown stations in the valley and in Salt Lake, connection was made from the Telluride Power Company's 40,000 volt system. This company has a duplicate pole line connecting Logan Power Station, 85 miles north of Salt Lake, with Prova Station, 45 miles south. Taps are taken off each of these lines at Salt Lake and the paralleling was done on the low tension side. From the first time this latter system was synchronized with other stations and switches thrown in, no trouble has arisen; the regulation is very materially improved for all.



VOLTAGE CHART UTAH LIGHT & POWER COMPANY.

On this combined system there are operated rotary converters supplying the street railway system, large induction and synchronous motors operating 550 volt railway generators, Portland cement mills, brick works, ore sampling works and various other plants scattered throughout the valley and in Salt Lake. On the Telluride Company's system are large induction motor mine hoists, mills, etc., in a half dozen of the largest mining camps in the state.

Since the general lighting systems for Salt Lake and Ogden, besides several smaller towns, are fed off this same large network, it speaks well for the regulation obtained, when it is considered the class of variable motor service and railway load carried. The voltage chart shown herewith is taken off the general lighting system in Salt Lake. The chief advantage in thus running all in multiple is the "momentum" that is back of all the severe changeable loads, motors starting, etc., so that no effect on the general system is noticeable.



POWER STATIONS AND TRANSMISSION LINES OF THE UTAH LIGHT & POWER COMPANY.

Within four weeks there will be started an additional steam three-phase unit of 750 k. w. capacity, and by October next another three-phase direct connected unit of 1000 k. w. capacity will be added. To the present rotary station for carrying the railway load will be added in September a 750 k.w. synchronous motor generator set.

By June next a sixth water power station, located on Bear river, 80 miles north of Salt Lake, will be completed and will be run in parallel with above systems. In this station two 750 k.w. Westinghouse units are being installed, and the transmission will be at 28,000 volts. By that time it it expected that the Cottonwood stations and the Pioneer station in Ogden Canyon will be changed over to transmit also at 28,000 volts, thus simplifying greatly the connections at the distribution end, for working in parallel.

The combined capacity of above stations, both steam and water, will reach 17,000 h.p.

The accompanying sketch shows the various transmission lines mentioned above, also location of power stations.

O. A. HONNOLD,
Division Engineer Utah Light & Power Company.

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AND ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Alternator Frames. This continent usually takes unto itself the credit of being considered the home of the latest developments in the electrical arts, but European engineers are now exploiting, and with apparent success, an idea which so far has found but little favor on this side of the Atlantic. We refer to the use of strutted frames for large direct driven alternators, that is, instead of having the iron of the stationary part of the machine held in place and supported by the cast iron box frame which is common practice with us today, they are experimenting with a steel structure, built up very similarly to the latticed girder work used in towers and bridges. This it is claimed gives a machine of equal rigidity and of materially less cost, the saving in material being very marked, besides which the plant cost would be still further reduced, as the lesser weight means a corresponding reduction in the outlays for freight and installation.

Amalgamation of Electric Companies. The announcement is now made that the Montreal Light, Heat & Power Company has succeeded in making arrangements for the control of the Lachine Rapids Hydraulic & Land Company. This will perhaps be not altogether welcome news to the consumers, who have hitherto looked upon the somewhat severe competition which has obtained in Montreal as a guarantee of a good service at a reasonable cost. We have every confidence, however, that the new organization will endeavor to treat its patrons, both present and prospective, in the best possible manner, and to provide an efficient service at a reasonable cost. It would almost seem reasonable that the rates might be reduced at no very distant date, as the operating expenses and fixed charges of the combination ought to be less than the sum of those incurred by the two companies now operating. It is reported that the price paid by the Light, Heat & Power Company is $190 per share, the Lachine Company being capitalized at $2,000,000. The price asked some few months ago, when the subject of amalgamation was being actively discussed, was $250 per share.

The Possibilities of Electricity. MR. Charles P. Steinmetz, in a recent paper given by him at Schenectady, N.Y., on the future possibilities of electricity, made some interesting remarks regarding his ideas of what it was likely to come to. Anent wireless telegraphy he seemed to think that it had a large future in the conducting of wars, as neither combatant would be able to destroy the enemy's communication by cutting wires. Further, it would probably be largely used in exploration work the world over, which would prevent the complete isolation which has hitherto been an accompaniment of all Arctic expeditions. Regarding the telephone it was stated to be yet in its infancy, trans-Atlantic communication being a question of but a comparatively short time. The complete superseding of the steam locomotive by the electric is, in his opinion, a very far distant change, commercial reasons rendering it of doubtful practibility. Mr. Steinmetz is an active exponent of the mercury vapor lamp, having developed a system which is in operation in his home at Schenectady, and for which he predicts a large field within but a comparatively short time.

Storage Batteries. The past month has seen the lapsing of one of the most important and broadest of the many patents affecting the electrical industry, namely, that issued to Charles F. Brush in 1886 and covering the construction of storage battery plates. It has been freely predicted that once this patent had expired there would be a substantial decrease in the price of this apparatus, and that its field of application would be correspondingly broadened, but it is practically impossible to prophesy truly as to what the future will bring out. Any interest which is protected by broad and fundamental patents has a most excellent opportunity, during the life of those patents, to fortify itself against the free competition which will undoubtedly arise as soon as the time limit has expired, and but few organizations neglect to avail themselves of the chance. In view of this it may very likely be found that while various companies may be free to manufacture the actual batteries, but few will be able to place their product into commercial service, owing to the subsidiary patents which cover various necessary accessories, such as boosters and the switchboard equipment.

Cleanliness in Central Stations. It is to-day a well known and universally acknowledged fact that the reliability and longevity of any piece of machinery are very much affected by the care taken to keep it in good condition. Especially is this true of electrical apparatus, in much of which the length of life is determined not so much by the actual amount of time it is in operation and the loads it is called upon to carry as by the state of cleanliness in which it is kept. "Show me his friends and I will describe you the man," is often heard in our midst to-day. "Let me see the fire hole and the dynamo room, and I will tell you whether or no he is a good man, a man worth having, a man fit to be in charge of your plant," is but another rendering of the same principle. When one goes into a power house and is confronted with dirt and dust, creeping oil and greasy clothes, untidy furniture and lamps half dimmed with the multitudinous deposits of many months, it is but small wonder that the man in charge is instantly ranked in the mind of an observant visitor or inspector as but a poor specimen. If the outside appearance of the apparatus and room is so neglected, one argues, perhaps unconsciously, it seems but reasonable to suppose that insidious dirt is hard at work in all the hidden corners and unseen spaces, the inevitable fruit of which will be frequent shut-downs and heavy repair bills, and so it is that a dirty and untidy engine and boiler room instantly militate against the engineer. So much for the view from the owner's standpoint. Let us survey it from that of the employee. How few and far between are the managers who will entertain suggestions for the purchasing of a decent set of repair tools and a place to keep them in, a liberal supply of brooms and waste and now and again a can of paint and varnish. Yet without them the incentive to keep the place in good condition is soon smoothered. How seldom does one find a station equipped with a good supply of spare parts properly stored for emergency use, even though their purchase had time and again been recommended by the engineer. How many of our plants are equipped with a compressed air system, notwithstanding that it has no equal as a quick and most thorough method of cleaning machinery, electrical apparatus particularly. To seem the matter up, employers should spend more money, and we refer more particularly to what are called small plants, on a liberal equipment of tools and cleaning utensils; employees should devote more time and attention than is usually given to the repairing and cleaning of the power house and the apparatus it contains. The money and the effort will both prove good investments, for without them no plant can possibly give the results which it otherwise is quite capable of producing.

The C. E. A. Convention. As our readers are perhaps aware, the annual convention of the Canadian Electrical Association is to be held in Toronto on June 10th, 11th and 12th next, of which full particulars will appear in a later issue. In the meantime we desire to urge upon all those connected with electrical industries, more especially the commercial men, that they should make a special effort to be present. As we have previously pointed out in these columns, no man who is debarred from even occaionally meeting his co-laborers and dicussing with them their mutual difficulties, experiences and methods can possibly produce results equal to those of the man who has availed himself of the opportunities of public discussion which are afforded by all conventions, and we would therefore say again to all our Canadian operating friends: Send along those of your staff to whom you look for results in the shape of dividends; it will be money well spent. We are aware, in saying this, that it may appear to be a somewhat sordid motive to urge, but the convention is really not intended to be a holiday for those attending, but rather an opportunity to benefit by the experience of men whose experience has run in lines different to our own. There are many electrical plants in the convention city possessing features of great interest to the members of the Association, the various officials of which will doubtless be glad to extend an invitation of inspection to the visitors. The city itself is one of the finest and prettiest on the whole continent, and the committee in charge of the convention arrangements are thoroughly equal to the task of providing a most entertaining programme of papers and discussions which will be of great benefit to those who hear and participate in them. May we again urge every manager and superintendent, especially of operating companies, to make special efforts to be present, and further to take part in the discussions. There are yet a great many questions affecting the industry which should be taken up vigorously by the Association both for the benefit of the individual members and the country at large.

THE "LONDON STANDARD LAMP."

Owners and operators of incandescent electric lighting plants should be interested in learning something about the merits of the above lamp, an illustration of which appears in the advertisement in this paper of the manufacturers, Messrs. Phillips & Company, of Edinhoven, Holland.

It is claimed for this lamp that it gives a maximum of light at minimum cost. The company make both high and low voltage lamps adapted to a variety of purposes, and would be pleased to send prices with full particulars of their goods to any of our readers who may write for same, mentioning their advertisement in the ELECTRICAL NEWS.

THE UNIVERSITY OF NEW BRUNSWICK AND ITS ENGINEERING DEPARTMENT.

The University of New Brunswick is located in Fredericton, the capital of the province of New Brunswick. The city is situated on a large level piece of land around which flows the St. John river in the form of a large bow. Back of the city rise the hills of the valley and part way up these hills is located the University.

Entering the University grounds, a long winding driveway through a grove of maple and beech trees leads up to the buildings, from which a most magnificent view of the city, of the St. John river, and of the surrounding country is obtained.

The University is supported by the Provincial Government and by the income derived from grants made by the Crown, as well as by the students' fees. It was first founded in 1800 by a Provincial Charter and called the College of New Brunswick. In 1828 a Royal Charter was granted by the Crown incorporating the college by name of Kings College. In 1859 an act establishing the University of New Brunswick and transferring to it all the lands, rights, endowment and other property of Kings College was passed by the Legislature of New Brunswick.

At present the University is governed by a body styled the Senate, the president of the Senate being the Chief Superintendent of Education. The Chancellor of the University, who directly manages the University for the Senate, is also a member of this body. The other members of the Senate are either appointed by the Government or elected by the Alumni Society and Teachers' Institute.

The University has four distinct courses and grants three degrees, namely, that of B.A., for the Arts course; that of B.Sc. for the Science course; and that of B.A.I. for either the Civil or the Electrical Engineering courses.

UNIVERSITY OF NEW BRUNSWICK, FREDERICTON.

The Engineering Department, which gives a degree in either Civil or Electrical Engineering, has been established only a short time, but has attracted considerable attention due to the rapid progress it has made and the thorough and efficient courses which it gives.

In May, 1900, the University celebrated its one-hundredth anniversary by laying the corner stone for its Engineering Building, and this was ready for occupancy in May, 1901. The electrical, cement testing, steel, iron, wood, brick and stone testing laboratories, workshop and janitor's room are located in the basement of this building. The basement also provides room for the engine, boiler, hot water heater, and storage battery, in addition to the dynamo, motor, testing machines, etc., used in the laboratories.

On the first floor are the Physical and Chemical laboratories, the Physical and Chemical lecture rooms, the Chemical store room and the Bursar's office. On the second floor are the drafting room, instrument room and engineering museum, a lecture room and library. The entire building is heated by hot water and lighted by electricity.

The Engineering students attend lectures in the Arts building as well as in the Engineering building. The Arts building contains the Mathematical, English, French, Classical, Natural Science and Philosoplical lecture rooms, the Natural Scienceand Philosophical laboratories, the main museum, library, reading rooms, Y. M. C. A., rooms, residency rooms, Chancellors' and Stewards' apartments.

The observatory contains an achromatic telescope, equatorially mounted, meridian transit and sidereal chronometers. Observations are taken for the Meteorological Survey of Canada.

The course in Civil Engineering extends over four years and is not narrowed down to any special branch, but is designed to fit the young graduate to take a position in any of the numerous special branches of Civil

Engineering by giving him a thorough training in the principles common to all.

The course in Electrical Engineering also extends over four years and is designed to furnish an extended training for students who desire to become specialists in the field of electrical science, with its numerous applications in modern industries. The leading subjects constituting the course are Theoretical and Practical Electricity, Physics, and those branches of Mechanical Engineering which are especially adapted to the wants of the electrical engineer. The theory of electricity is thoroughly taught and is supplemented by an extensive laboratory practice. The University has been granted the use of the dynamos, motors, lines, etc., of the Fredericton Electric Lighting Company, and each year a number of practical tests are made to enable the student to become familiar with many of the appliances used in the generation and distribution of electricity.

Engineering Building, University of New Brunswick, Fredericton.

The Canadian General Electric Company, of Toronto, has presented the University with a 3-kilowatt compound dynamo and rheostat, a 3-kilowatt shunt motor, two switches, a voltmeter, and an ammeter, while the University has purchased a storage battery and the apparatus necessary for wireless telegraphy, and is granted the use of an X ray outfit.

Steam Engineering is taken up in the third year. The theory of heat is first thoroughly studied, so that the student may be prefectly familiar with the laws and formulæ governing the production and expansion of steam. The various kinds of boilers and the methods of determining the grate surface, heating surface and chimney area required for a boiler of any horse-power are then discussed. After this the theory of the steam engine itself is taken up and experiments are made with the engine at the University to determine its indicated horse-power.

In the first two years of the Electrical Engineering course the student is taught English, French or German, Mathematics, Botany, Drawing, Surveying, Logic and Physics, and must prepare a thesis during the summer vacation descriptive of an engineering work or structure. In the third and fourth years the course is as follows :

THIRD YEAR.

1, Calculus ; 2, Applied Mechanics ; 3, Physics ; 4, Theory of Steam Engine ; 5, Lectures in Elements of Electricity and Magnetism, with particular references to Thompson's "Lessons in Electricity and Magnetism." 6, Lectures on Electrotechnics : Primary and Secondary Batteries, the Telephone and the Telegraph; 7, Electrical Measurements : Carhart and Patterson's Laboratory Manual is used ; 8, Chemistry.

FOURTH YEAR.

1, Graphic Statics; 2, Hydraulics; 3, Theory of Electricity : Mathematical Theory of Electricity and Magnetism (J. J. Thompson), Theory of Electricity (Cumming), and Theory of Electricity (Gray), are recommended for reading in connection with these Lectures ; 4, Lectures on Electrotechnics : Systems of Distribution, Incandescent Lamps and their Manufacture, Arc Lights and their Regulation, Electrolysis ; 5, Dynamo-Electric Machinery: Dynamo-Electric Machinery (S. P. Thompson) and Dynamo-Electric Machinery (Urquhart) are recommended for reading in connection with these Lectures ; 6, Laboratory work, including Calibration of Instruments, Dynamo Tests, etc. ; 7, Thesis. A Thesis on some subject within the field of Electrical Engineering must be submitted to the Professor in charge at least two weeks prior to final examinations. Diplomas in Electrical Engineering will be awarded to those candidates only who present acceptable Theses.

There are at present forty-one engineering students at the University. The students of the first, second and third years are required to attend a summer camp for the purpose of making surveys for a short line of railway. This survey is mapped and traced by students of the fourth year.

The Engineering Society of the University of New Brunswick is open to students, practising engineers or those interested in Engineering. The Lieutenant-Governor of the province is honorary-president and many prominent engineers of the Maritime Provinces are enrolled as members. Meetings are held in October, November, January, February, March and April, at which papers are read and discussed by the members. This society has proved itself to be a great benefit to the engineering students.

The members of the Engineering Faculty and those of the Arts Faculty who assist in engineering subjects are given below :—Dean of the Engineering School, Professor of Civil Engineering and Lecturer in Chemistry, Ernest Brydone-Jack, B.A., C.E., Associate Member American Society of Civil Engineers, Member Society for Promotion of Engineering Education; Arthur Melville Scott, B.A., Ph.D., Prof. of Physics and Electrical Engineering and Lecturer in German ; Thomas Harrison, M.A., LL.D., Chancellor of the University and Professor of Mathematics ; Loring W. Bailey, Ph.D., LL.D., F.R.S.C., Professor of Natural History and Geology ; William Hall Clawson, M. A., Professsor of English and French ; J. Woodbridge Riley, Ph. D., Professor of Philsophy and Political Science ; Ralph St. John Freeze, Student-Assistant Chemical Laboratory.

PROF. E. BRYDONE-JACK.

Professor Brydone-Jack was appointed Dean of the Engineering Faculty in May, 1902, retaining at the same time the professorship of Civil Engineering to which he had been called the previous year. He has had a large and varied experience in practical work, having worked on or had charge of detail designs for many well-known engineering structures, such as the viaduct for extension of Riverside Drive, New York, part of the Boston subway, part of the Southern Union Station, Boston, and the Rankin bridge having the heaviest 500 foot span then built. He was also engaged in railroad work on the St. John Valley and Riviere du Loup Railway surveys, on the Harvey-Moncton short line surveys, with the Delaware & Hudson Canal Company, and with the Buffalo, Rochester & Pittsburgh Railway Company. He was engineer in charge of one of the branch offices of the Keystone Bridge Works, then a part of the Carnegie Steel Company, for one year, and before taking the chair of Civil Engineering at the University was engineer in charge of the drafting department of the Fort Pitt Bridge Works. At present he also holds the position of City Engineer for Fredricton, N. B. He is thus eminently qualified to give a thorough and practical course in Civil Engineering and to direct the work of the Engineering Department.

PROF. E. BRYDONE-JACK, B. A.
Dean of the Engineering Faculty and Professor of Civil Engineering, University of New Brunswick.

DR. A. M. SCOTT, B. A.
Professor of Electrical Engineering and Lecturer in German, University of New Brunswick.

Professor Brydone-Jack was born in Fredricton, N.B., in 1871, his father having been President of the University from 1861 to 1885. He obtained his High school education under the well known Dr. Parkin (who is now acting for the trustees of the Cecil Rhodes scholarships), winning the prizes for the best general standing in the different years, as well as winning the Douglas Medal for Classics and the Mathematical Prize. In September, 1887, he entered the University of New Brunswick, matriculating at the head of his class and taking the York County Scholarship. After taking the full four years' arts course he graduated at the head of his class in 1891 with degree of B.A. He then entered the Rensselaer Polytechnic Institute of Troy, N. Y., taking the full four years course in three years, graduating with degree of C.E. in 1894, also winning the prize given in the junior year for the best summer thesis of the class. From 1894 to 1901 he was engaged in the active practice of his profession.

Professor Brydone-Jack is a member of the Society for the Promotion of Engineering Education, as well as an Associate Member of the American Society of Civil Engineers. He also organized last year the Engineering Society of the University of New Brunswick, the membership of which includes many of the prominent engineers of the Maritime Provinces and vicinity, as well as the students of the University.

DR. A. M. SCOTT.

A. Melville Scott, B.A. (Toronto '96), Ph.D. (Gottingen '98), Professor of Physics and Electrical Engineering, was appointed to his present position in 1899, after having spent the preceding year as instructor in the Department of Physics at the University of Toronto.

He is a native of Ontario, served his apprenticeship at teaching in the public schools of that province, and, attending the Normal School at Toronto, succeeded in winning the Gold Medal in June, 1890. After two years spent at the Parkdale Collegiate Institute he entered the University, taking the Honor Course in Mathematics and Physics, in which he obtained a foremost standing throughout, at the same time reading largely in English and other modern languages. In addition to scholarships and prizes during the preceding years, the McDonald Gold Medal for Mathematics and Physics, and the Aberdeen Gold Medal for General Proficiency from Victoria College, fell to his lot at graduation, also in addition the 1851 Exhibition Science Scholarship was awarded him by the University for research work carried on during the fourth year. The two years following graduation were spent in Germany in further study and research at the University of Gottingen ; during this time many opportunities were afforded him of visiting the various parts of Europe, centres of commerce and of manufacturing industries, as well as seats of learning.

With a wide range of experience and a many-sided view of life, Dr. Scott is now devoting his energy and ability as a teacher to the improving of the facilities for technical education in the Maritime Provinces, especially New Brunswick, as furnished by the Engineering Department of the University of New Brunswick. Under his direction the incipient course in Electrical Engineering is becoming firmly established, and bids fair to be as popular as the older course in Civil Engineering.

SOME ELECTRICAL FEATURES OF THE UNIVERSITY CONVERSAZIONE.

By C. Chant, Ph. D.

At the recent Toronto University College Conversazione, held on the evening of March 19th, two of the electrical exhibits were of special interest. These were the demonstrations of wireless telegraphy and of the Simon "singing arc lamp."

In the former, two systems were shown. One of these was that devised by Prof. Braun and the firm of Siemens & Halske. The apparatus exhibited in operation is suited only for short distances (100 yards being the greatest distance to which signals have so far been sent,) but the instruments are precisely of the pattern used in long distance work. They were purchased by the University at the request of the writer, for use in an investigation now being made into some of the phenomena of wireless telegraphy. The little transmitter with its eight miniature Leyden jars and its small transformer, actuated by a small induction coil fed by two accumulators, was placed at one corner of a large hall while the receiver was at the oppossite corner, about thirty yards away. Connected with the latter was a Morse register, kindly loaned by A. B. Smith, Esq., of the G. N. W. Telegraph Company, and signals were freely received either by the ringing of the call-bell or by markings on the paper tape. The antennae were but 2½ metres long, the wave-length used being ten metres.

But the most convincing exhibition was with the De Forest system. When communicated with, Mr. Thomson, the manager of the De Forest Company, and Dr. de Forest gladly agreed to assist in the exhibition, and Messrs. H. E. Athearn and J. A. Wallace freely offered to be present and send and receive actual messages.

The regular alternating-current transmitter used in this system could not be conveniently installed, so one with a medium-sized induction coil was improvised. The antenna, which was nine metres long, was suspended from the ceiling by a cord, the ground connection being to a steam-heating radiator near by. This transmitter was placed on the same table as the little Braun sender. About 110 feet away, and separated by three solid brick walls, the little "dinky" responder—small enough to be put in a coat pocket—was placed on a table at which sat the receiving operator with the head-telephone on. The effect on the responder was so strong when one side of it was joined to a radiator that no antenna was used.

For two hours the visitors wrote messages (on the ordinary blanks) and handed them in at the sending end, where they were promptly despatched at the usual telegraphic speed ; and those to whom they were addressed, on calling at the receiving office, were delighted to have their "aerograms" handed them, sent without a mistake. Indeed, to test the operators, Prof. Masson, of Victoria College, sent a message in French, and it reached the proper person without a slip. During the evening nearly fifty messages were sent and received, constituting an excellent demonstration of the reality of the new system.

About ten feet farther away from the sending station, on the other side of a fourth brick wall, the writer had arranged another receiving station. At this place the responder was simply joined in series with two dry cells and an ordinary telephone receiver ; while an antenna ten metres long, suspended from the ceiling, was joined to one side of the responder, the other side being connected to a sheet of tin about 2x3 feet lying on the floor. No connection at all was made to earth. The signals here were perfectly clear, and astonishment was expressed at the wonderful results with such simple means. The De Forest responder is certainly an extraordinarily sensitive and effective instrument.

Amongst those who received messages or sent them may be mentioned : Mrs. Moss, wife of the Vice-Chancellor of the University ; Mrs. Harcourt, wife of the Minister of Education ; Mrs. A. B. Macallum ; Prof. Baker ; Prof. DeLury ; Registrar Brebner ; and many others.

Some interesting observations were made when testing the experimental arrangements on the previous evening. When the large transmitter (with 9-metre antenna) was in action, the Braun receiver (with 2 1/2 metre antenna), 30 feet away, was unaffected ; but when this antenna was made ten metres long, and especially when earthed to a radiator, the signals were pretty freely received. Also, when the Braun sender, with 2 1/2 metre antenna and no earth connection at all, was in operation the messages were read with the De Forest responder at a distance of 120 feet, with four solid walls intervening, one side of the responder being joined to a radiator but no antenna being used.

The "singing arc" was arranged under the direction of Prof. Rosebrugh, of the Faculty of Applied Science. A phonograph was in one room, while the arc lamp was in another room across a hallway and about fifty feet distant. Tunes uttered by the former in the neighborhood of a carbon microphone were repeated by the brightly-shining lamp, so as to be heard by all in the room. The lamp was exhibited by Mr. M. V. Sauer, of the Department of Electrical Engineering.

AMALGAMATION OF ELECTRIC COMPANIES IN MONTREAL.

On March 17th negotiations were concluded by which the Lachine Rapids Hydraulic & Land Company, of Montreal, was absorbed by the Lontreal Light, Heat & Power Company. It is understood that the price paid for the Lachine Company's stock was $190 per share or a total of $3,800,000. The Light, Heat & Power Company have thus acquired the Lachine Rapids Company, the Citizens' Power Company, the Standard Light & Power Company, and a lease of the Shawinigan Water & Power Companys' plant in Montreal.

The public have been assured in a degree that prices for electric current will not be advanced by the offer of the company to close contracts for both gas and electricity at current rates for a term of one, three, five, or ten years.

Mr. Rodolphe Forget, second vice-president of the company, is authority for the statement that all the power generated by the different plants will be centered at the Queen street station, which was built to take care of 100,000 horse power. He points out that before the end of this year the company will be recieving over 80,000 horse power, i.e., 23,800 h.p. from Chambly, 6,000 h. p. from Ste. Therese, 12,000 h. p. from Lachine, 8,000 h. p. from Shawinigan, and 30,000 h. p. from Soulanges Canal. Friends of the company control also the St. Louis Power Company's proposition opposite Heron Island, which will be developed as circumstances require. Mr. Forget expresses the opinion that out of the 80,000 horse power of steam production now used in Montreal, 75 per cent. will be replaced by electricity within the next five years.

It is reported that persons representing the Montreal Light, Heat & Power Company have acquired control of the Jacques Cartier Light & Power Company at Quebec.

QUESTIONS AND ANSWERS

The question submitted by the Hamilton subscriber signing himself "Armature" is not sufficiently clear to enable a reply to be given. If he will explain more fully the points on which he desires information, we shall be glad to answer.

"J. R.": What is the proper locations for alternating current lightning arresters? Are double or single pole the most desirable to use? Are they ever placed on the secondaries?

Ans.—As a general rule arresters are placed at both ends of a line, and also at the ends of any branches. Further than this, it is usual to install a set beside any large machine or group of apparatus, and also, if the line be hilly, it is sometimes found advisable to locate a set on the top of any prominent rise. It is generally considered preferable to put in single pole equipments instead of double pole, as they somewhat lessen the chance of short-circuits occurring if a heavy discharge should damage the arrester, though two single pole equipments will naturally cost somewhat more than one double pole. We do not know of any installations in this country which have arresters on their secondaries, though we believe that they have very occasionally been used on the other side.

"R. M. Smith": Why are induction motors not built for high potentials such as 6,000 and 10,000 volts? We often see synchronous motors operating at those pressures.

Ans.—The greater number of turns per coil which are necessitated by these high voltages, as compared with the more moderate pressure of 500 or 1,000 volts, makes it impossible to build an induction motor which would have a sufficiently high power factor for commercial purposes. This objection does not hold good for those of the synchronous type, whose power factor is controlled by the excitation furnished from the exciter, and which can be made practically unity if the load does not vary too rapidly.

"L. M.": We have a 2000 volt single phase circuit which according to the wattmeter is carrying 105 k.w., and in which the power factor is 90 per cent. What is the current?

Ans.—When the wattmeter registers 105 k.w., the power factor being 90 per cent., it means that this reading is but 90 per cent. of the kilo volt amperes in the circuit, or in other words, that the k.v.a. flowing is $\frac{100}{90} \times 105$. The current is then $\frac{100}{90} \times 105 \div 2000 = 58\frac{1}{3}$ amperes.

"Ned": How would you build a concrete dam 66 ft.x15 ft. high? How much stone is required? How many waste gates would you put in it to control eighty-seven square miles of water? Where would you put them? I want to connect a fifty horse power water wheel under a 13 foot head, what size spout should I use? Is a wooden spout or an iron spout the best? Another 60 h.p. water wheel is to be connected 200 feet from the dam. What size spout should I put in? What company in Canada makes a good water gate? Will cement set in still water? Where can I get some illustrations of dams, or a good practical book on water powers, dams, etc.?

Ans.—We regret that we are unable to answer your various questions, as anything in the shape of a satisfactory reply involves an investigation into drawings, layout, etc., far beyond the scope of this department. We would suggest that you communicate with one of the consulting hydraulic engineers whose cards you will find in this paper.

"Reader": What is the Ward-Leonard or turret system of motor control?

Ans.—The principle used in this system is that of varying the voltage impressed upon the armature of the motor by changing the voltage produced by the generator, instead of inserting rheostats into the motor armature circuit. This latter, if shunt wound, has to be provided with some source of field excitation other than the line which supplies the armature. It will be evident from the above that a generator is needed for each motor, unless two or more of these latter are required to have their speeds varied simultaneously and to the same extent. The system is more particularly for use in those plants where a large motor requires to have its speed varied over a large range and by very fine steps, the economy over rheostatic control being very marked, and the various changes in speed being controllable by the operator to as fine an extent as is desired.

"Dynamo Tender": Can you give me any information as regards a good method of keeping commutators true without turning them? Sandpaper does not seem to do it.

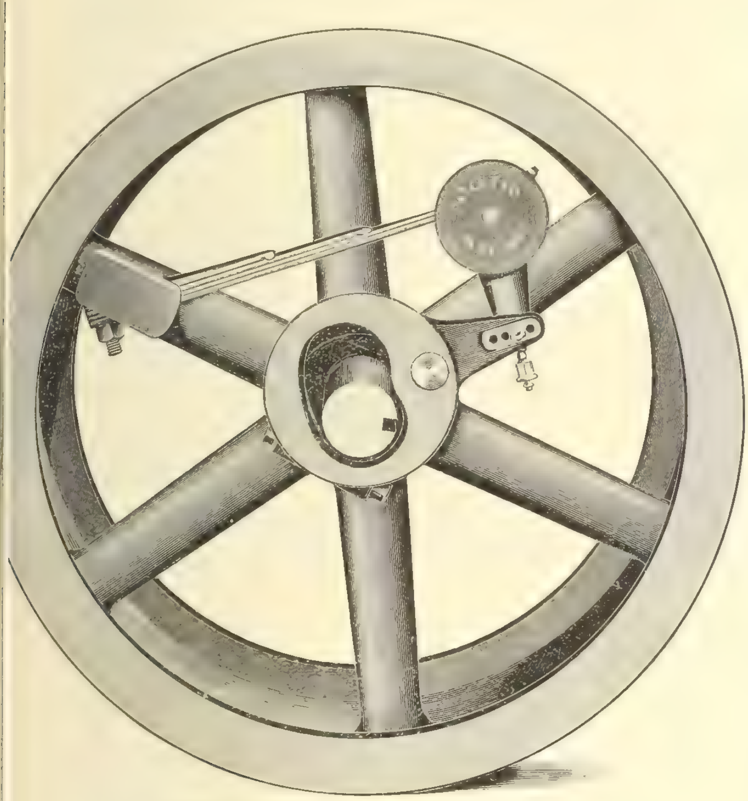
Ans.—You can accomplish a good deal by cutting a good sized block of sandstone to the arc of the commutator, and holding it on while the machine is run at a fair speed similarly as sandpaper is used. This will cut down the high places and give you a good surface if things are not in too bad a condition, though the process is somewhat slow compared to turning. Be sure before you start that the commutator is tight, otherwise you may find yourself as badly off as ever in the course of a couple of weeks, with all your labor lost.

"Montreal Resident": Would you please tell me the meaning of the term "concatenation" when used in connection with induction motors.

Ans.—It is an expression used to designate the connection of two induction motors in series with each other, somewhat after the style of the series connections used in the control of street railway motors. In this latter case the two machines are connected strictly in series and the same current goes through both, but when using induction motors there is a slight difference, the secondary of the first machine being connected to the primary of the second, and supplying current to it at a frequency just half of that of the supply circuit. The two motors are thus run at about half normal speed, the first because its armature has got a resistance connected into it, namely, the field of the other machine, and the second because the frequency of the current supplied to it is half the normal. The method is practically never used commercially except in polyphase railway work, where it affords an economical method of obtaining low speeds, similarly to the true series parallel system as applied to direct current apparatus.

THE ROBB-ARMSTRONG-SWEET GOVERNOR.

The design of centrifugal governors has occupied the attention of engine designers and builders ever since steam engines have been used, and particularly of late that form of governor which is placed in the fly-wheel of the engine and is attached to, or forms part of, the valve-driving mechanism and arranged to vary the point of cut-off of steam in the cylinder automatically. It has been found especially difficult to get a governor powerful enough to operate the valves and valve gear regularly and, at the same time, to give sufficiently close and quick regulation to meet the very exacting requirements for driving electric generators, particularly for lighting or combined lighting and power service and for parallel operation of alternating current generators. This type of governor has appeared in almost numberless forms, many of them more or less successful, but all lacking absolute perfection either in governing qualities or in mechanical details. In order to prevent disturbance of the governor by reciprocating valves, various friction devices have been used as a part of the governor or in connection with it, such as double eccentrics, dash pots, drag springs, etc., and while these give a certain measure of stability, they prevent quick regulation and are liable to cause the governor to race or hunt.



ROBB-ARMSTRONG SWEET GOVERNOR.

The governor invented by Professor John E. Sweet was a decided advance over earlier types, having a less number of parts, only one weight and one spring, the governor system in perfect gravity balance in all positions, and great centrifugal power with less friction in the moving parts than previous forms of governor.

The Rites type of governor forms another step in advance, as it utilizes the inertia of a heavy weight suspended in the fly-wheel to give quick governing. The arrangement of the inertia governor is such that any change of speed causes the fly-wheel and the suspended inertia weight or arm to which the eccentric is attached to change their relative positions, so that the cut-off is changed quickly to meet a sudden change of load. The inertia of this heavy arm also prevents, to a certain extent, disturbance of the governor by the reciprocating motion of the valve. The disadvantages of this form of governor are (1) that the inertia weight and eccentric being all in one piece must be out of gravity balance in order to have centrifugal force, and the governor system not being in balance, is caused to oscillate, especially at slow speeds. (2) The strain due to the centrifugal force and gravity of the heavy inertia arm is carried directly by the suspension pin, which is not easily lubricated; therefore, both from the absence of gravity balance and because of the increased strain and friction, the designer cannot introduce very much centrifugal force, with the result that the regulation is influenced greatly by any variation in the friction of the valve or valve gear, tight or loose packing of the valve rod, change of steam pressure, etc., and if the suspension pin gets dry, as it is liable to do while moving under heavy pressure, the governor is sure to regulate badly. (3) Although inertia tends to overcome friction and cause quick movement, unless the movement is controlled by powerful centrifugal and centripetal forces, the governor will not be stable, and the Rites type of governor cannot have these powerful forces without being correspondingly out of gravity balance, nor without great strain and friction on the suspension pin.

The real controlling power in a governor depends upon the amount of the unbalancing of the centrifugal and centripetal forces, and this may be made sufficient in amount (1) by a great change of speed, or (2) if the centrifugal and centripetal forces are strong, a small change of speed will cause a considerable unbalancing of the forces and a correspondingly quick change of the governor to a new position where the forces are again in balance. If there were absolutely no friction or inertia in the moving parts of the governor, any unbalancing of the forces would cause the governor to move instantly to a new position where the balance would be restored. The more friction there is the slower the mechanism will adjust itself to the new position, and the effect of slow movement is to allow a further change of speed, and that the governor will move too far and then come back, with the result that there will be a constant hunting to find the proper position.

In the Robb-Armstrong-Sweet governor the manufacturers claim that centrifugal weight is carried by the spring directly, so that the heavy strain due to centrifugal force is not brought on the suspension pin, which merely carries the eccentric and is not subject to any strain or friction except that due to the driving of the valve gear. The governor system is in gravity balance in all positions, because the eccentric is made to balance the centrifugal weight, the principle of balancing being the same as that invented by Professor John E. Sweet and employed in the Straight Line engine governor.

The centrifugal weight may be very heavy without bringing undue strain on the spring, because a large part of its centrifugal force is carried by end pull on the flat leaf spring, so that the inertia of the weight is sufficient to prevent disturbance by the reciprocating motion of the valve gear, and the weight is so placed that it also gets the effect of inertia for quick regulation. The result is an extremely simple and powerful governor, in which there is not enough friction to prevent the governor from changing position almost instantly, and no possibility of racing when properly adjusted.

The eccentric being under reversing strains, from driving the valve gear, allows the oil to reach the rubbing surfaces of the suspension pin and bush, so that there is practically no friction or wear. Other important advantages are that by means of a simple adjustment of the link connecting the eccentric and centrifrugal weight, the governor may be adjusted to any degree of sensitiveness or close regulation; if desired, the engine may be made to vary only one revolution from no load to full load, and the operating engineer by simple directions may change the speed of an engine at any time.

This governor is the joint invention of Mr. E. J. Armstrong, of New York, and Messrs. D. W. and A. G. Robb, of Nova Scotia, based on Professor Sweet's invention, and is patented in the United States, Canada and European countries.

THE ELECTRIC CLUB OF PITTSBURGH.

The first annual report of the Electric Club of Pittsburg, Pa., is issued in the form of an attractive booklet under date of March 19, 1903, the anniversary of the Club's organization. This pamphlet, of artistic design and illustration, gives the constitution and membership of the Club, the scope, plans, and personnel of the various committees, and an outline of the work accomplished and proposed. A feature of this work which has proven very valuable is the formation of classes for the study of technical subjects under the instruction of various engineers of the Westinghouse Electric & Mfg. Company. These classes, or "sections", constitute "self exciting" engineering societies within the parent body, each section pursuing a separate and definite line of study. As a further aid, there is a well equipped technical library, including the varions electrical and mechanical magazines.

Fogarty Bros., of Montreal, have been awarded the contract for power, lighting and telephone installation in a new building to be built in that city by the Hudson Bay Knitting Company, also lighting installation in A. Beck's new factory.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, March 31, 1903.

Toronto and some other localities in Ontario seem to wage increasing war on the Bell Telephone Company. Just why, we in Montreal cannot fathom. Down here we get a good, prompt service, and fair treatment generally, and those of us who have had the experience of two telephones in the office as in the days of the Federal Company found the situation more of a nuisance than a convenience. The telephone to be of any practical value must be a monopoly, although the government must be expected to safeguard the public against exorbitant rates.

The long looked for amalgamation of the Montreal Light, Heat & Power Company and the Lachine Rapids Company has at last come to pass. Just why such positive denials were made by prominent officials on both sides a few hours before the announcement, and after the deal was practically consummated, is a puzzle that no fellow can guess. Whether the deal will ultimately be of benefit to the public or no remains to be seen ; the consensus of public opinion at present, however, is to "expect higher rates." It must be borne in mind that there is a tremendous amount of power to be disposed of and the market for same has a limit even if the Montreal Street Railway is supplied. The street railway themselves will probably "come into the fold" ere long. The consolidation may have the effect of increasing the demand for isolated plants in factories, etc., in which case the wisdom of the Canadian General Electric Company in purchasing the old Royal Electric shops for the manufacture of dynamos and apparatus will be more than ever shown.

MOTORS FOR THE LACHINE CANAL.

MONTREAL, March 21st, 1903.

Editor ELECTRICAL NEWS :

DEAR SIR,—We note that under the heading "Sparks", the statement has been made that the Dominion Government has placed the order for electrical equipment of the Lachine Canal with us. This is correct, but the forty-nine motors are not to be all alternating. Thirty-one motors are alternating current, and are supplied by the Ampere Electric Company, of whom we are selling agents, and eighteen motors are direct current, and are being supplied by the Crocker Wheeler Company, for whom we are the Canadian agents.

Yours truly,
R. E. T. PRINGLE COMPANY, LIMITED.

The Canadian General Electric Company have secured the contract to supply the Hamilton Electric Light and Cataract Power Company with five 100-light constant current transformers and 430 series alternating current enclosed arc lamps, with necessary switchboards and other accessories.

Defective welding of boiler tubes may be readily detected by chemical means, according to a communication by Mr. D. Woodman before a joint session of chemical societies at the Chemists' Club, New York. A certain lot of boiler tubes had given very poor results, corroding to failure very rapidly; another lot subjected to precisely similar conditions had been satisfactory. Submitted to Mr. Woodman for analysis, he found them to be of practically identical material—a fair quality of wrought iron. It was then suggested that possibly differences in the welding might have something to do with the behavior of the tubes. This was tested by laying sections of each kind of tubes in 10% sulphuric acid. The good tubes were attacked uniformly all around, the line of the weld showing merely by its color. The other tubes, however, were eaten away on the line of the weld very rapidly, so that a deep slit was formed there. This indicated that the metal along the weld was porous and open; in other words, that the weld was imperfect.

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MOONLIGHT SCHEDULE FOR MAY.

Date.	Light.	Date.	Extinguish.	No. of Hours.
May 1	7 30	May 2	4 10	8 40
2	7 30	3	4 10	8 40
3	11 20	4	4 10	4 50
4	0 00	5	4 10	4 10
6	0 40	6	4 10	3 30
7	1 10	7	4 10	3 00
8	1 45	8	4 10	2 25
9	2 10	9	4 10	2 00
10	No Light	10	No Light	
11	"	11	"	
12	"	12	"	
13	7 40	13	10 30	2 50
14	7 40	14	11 20	3 40
15	7 45	15	0 00	4 15
16	7 45	17	0 45	5 00
17	7 45	18	1 20	5 35
18	7 45	19	2 00	6 15
19	7 50	20	2 30	6 40
20	7 50	21	3 00	7 10
21	7 50	22	3 30	7 40
22	7 50	23	3 30	7 40
23	7 50	24	3 30	7 40
24	8 00	25	3 30	7 30
25	8 00	26	3 30	7 30
26	8 00	27	3 30	7 30
27	8 00	28	3 30	7 30
28	8 00	29	3 30	7 30
29	8 00	30	3 30	7 30
30	8 00	31	3 30	7 30
31	8 00	June 1	3 30	7 30
		Total		161 40

TEST OF A TRANSFORMER.

A recent flood in the city of Montreal was the cause of an unconscious, yet interesting, transformer test. Two 25 kilowatt type A O transformers became submerged in water and remained in that condition for 48 hours. When the water subsided they were found in operation and performing the usual duties. This is a good illustration of the excellent construction and durability of the modern transformer.

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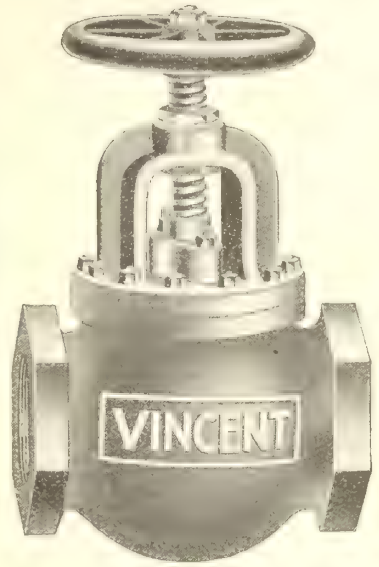

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It's honest all the way through.

Not a single item enters into its make-up but what has been tested and proven true.

For a high speed engine the McEwen is an economical engine.

Its regulation is perfect and it gives a most satisfactory service for the special purposes for which it was designed.

OUR GUARANTEE

The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution.

Any engine failing to meet this guarantee becomes the property of the purchaser upon the payment of one dollar.

For street railway service, electric lighting, electric crane work, mine haulage or any service where loads fluctuate with rapidity the McEwen is the ideal high speed engine.

Its guarantee given herewith proves our contention that the McEwen has almost perfect regulation. We should be pleased to send you the catalogue of the McEwen showing its construction embodied in its making.

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Branches: Winnipeg and Vancouver

PUBLICATIONS.

The Westinghouse Electric & Manufacturing Company, of Pittsburg, have issued a neat and attractive booklet descriptive of Westinghouse fan motors for alternating and direct current circuits. In it are illustrated a few of the many adaptations of fan motors in stores, hotels, restaurants, steamers, trains, etc.

"The Induction Motor, its Theory and Design", by Boy de la Tour: This book has been translated from the French by C. O. Mailloux. It is intended to illustrate the theory of the induction motor and to facilitate its design by a practical method of calculation which is at once simple, ingenious and effective. The publishers are the McGraw Publishing Company, 114 Liberty street, New York, and the retail price is $2.50.

"Storage Battery Engineering," by Lamar Lyndon: This book has just been published by the McGraw Publishing Company, of New York, and retails at $3.00. It is a practical work intended for the engineer who is called on to design and install storage battery equipments or who has a battery power plant under his care. Various systems of boosters are minutely described. Altogether the book forms a complete compendium for the engineer, to which questions which may arise in storage battery work may be referred and satisfactorily solved.

In future Science Abstracts, of London, England, will be published in two sections. Section A will embrace physics, heat, sound, electricity and magnetism, chemical physics and electrochemistry, general physics, meteorology and terrestrial physics, physical astronomy. Section B will embrace steam plants, gas and oil engines, automobiles, driven ships and launches, balloons and airships, general electrical engineering, electric generators, motors and transformers, electrical distribution, traction and lighting, telegraphy and telephony. The subscription price will be $4.50 for each section separately including index, or for the two sections $7.50.

We are advised that Messrs. Peacock Bros. (late Francis T. Peacock) Canada Life Building, Montreal, have been appointed sole representatives for the Dominion of Canada for Messrs. Turner Bros., the well known English manufacturers of sheets, bars, forgings, stampings, etc., for electrical purposes.

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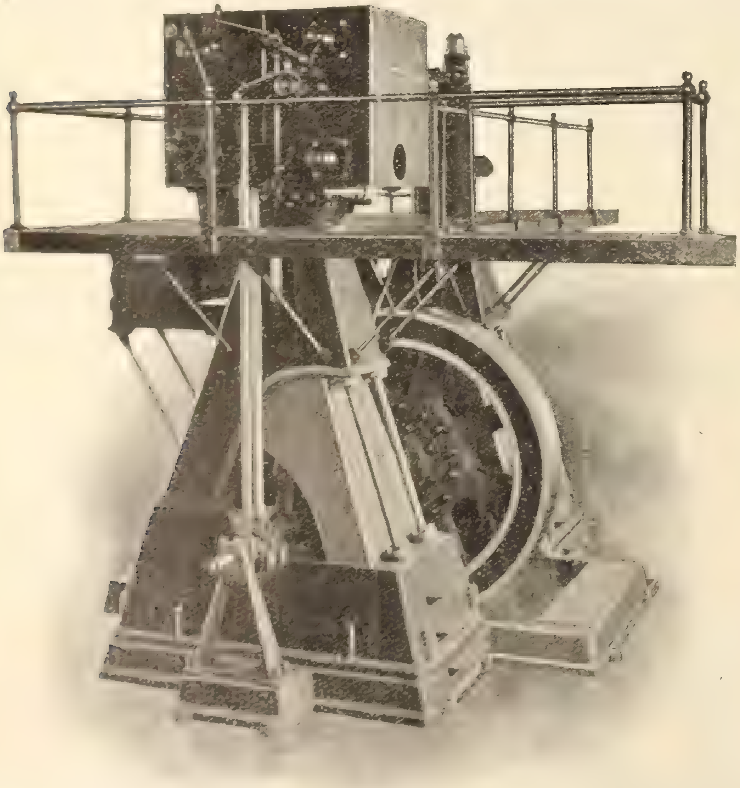

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British Columbia Electric Ry. Co. - 2,100 H. P.
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Toronto Electric Street Ry. Co. - - 1,500 H. P.
Montreal Street Railway Co. - - 11,500 H. P.
Dominion Iron & Steel Co. - - 2,400 H. P.
Cape Breton Electric Tramway Co. - 1,200 H. P.

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SPARKS.

The Northern Electrical Manufacturing Company, Madison, Wis., have issued booklet No. 31 describing and illustrating Northern direct current generators. The booklet will be sent free on request.

The Canadian General Electric Co., Toronto, and the Waterous Engine Works Co., Brantford, have contributed $500 and $400 respectively towards the cost of equipping the new engineering laboratory of Queen's University.

The village council of Weston, Ont., has decided to charge a uniform rate of 32 cents a month for sixteen candle power lamps and 16 cents for eight candle power. Heretofore the rate has been 30 cents for 15 c. p. lamps, with a sliding scale of prices for the number of lamps in use.

The town of Midland, Ont., has accepted the tender of the Goldie & McCulloch Company, of Galt, for the supply of an engine for the electric light plant. The price is $2,300 and the old engine.

The Ampere Electric Mfg. Company are building two induction motors, each of two hundred h.p. capacity, for operating the new linoleum mills of the Dominion Oil Cloth Company, Montreal; a 75 h.p. induction motor for the Locomotive & Machine Company of Montreal, and two 50 h.p. motors for the Canada Axe & Harvest Tool Mfg. Company, besides the usual drift of smaller size.

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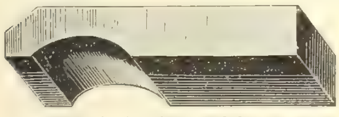

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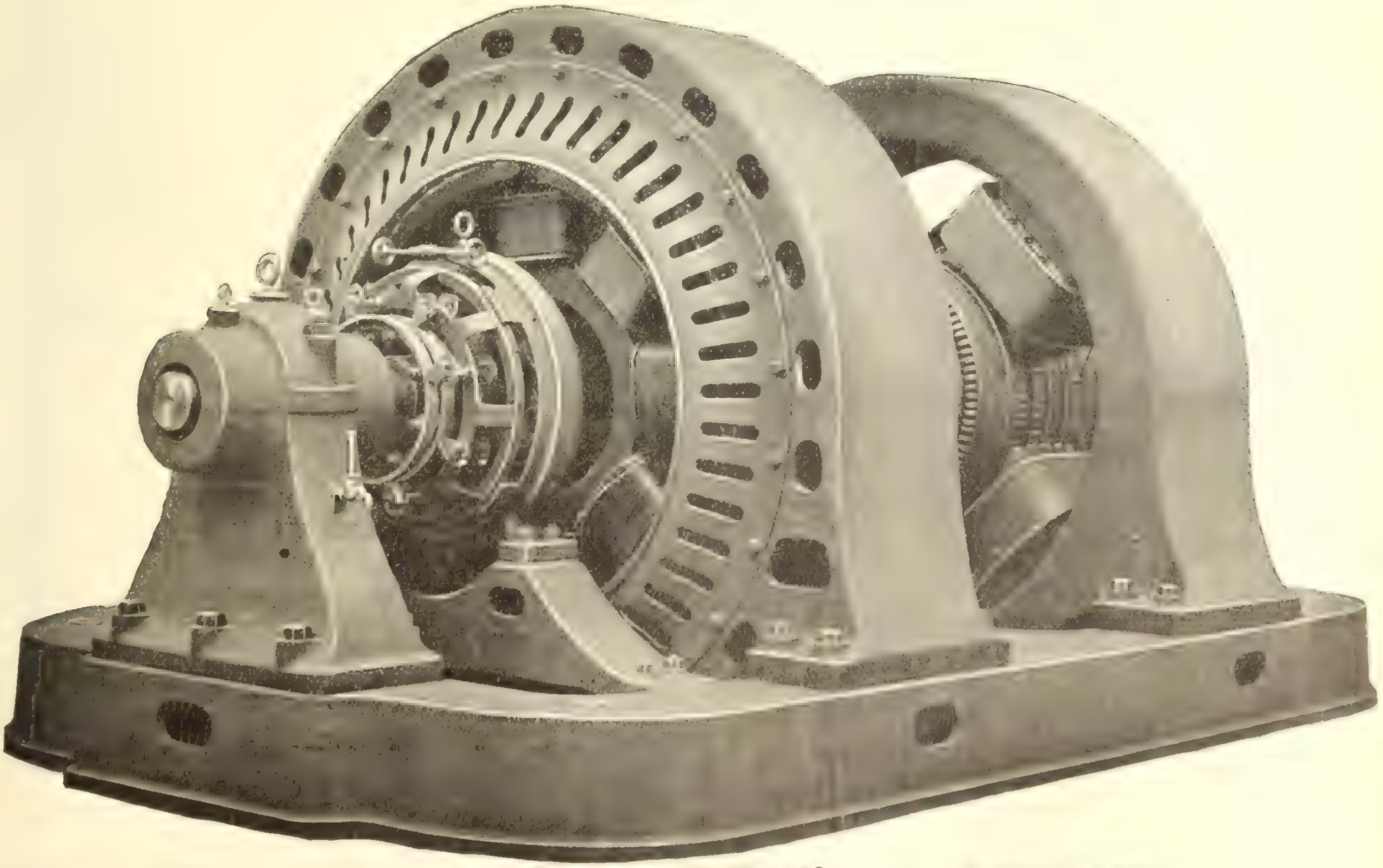

Head Office: 110 Cannon Street, LONDON, E. C., ENGLAND.
Canadian Office: 332 King Street, KINGSTON, ONTARIO.

SPARKS.

The business of the Dominion Motor & Machine Company, Toronto, has been acquired by Power Accessories, Limited, of which the provisional directors are Messrs. E. J. Philip, J. J. Main, H. S. Pell, Joseph Wright, and Frank Denton. The capitalization is $150,000.

Incorporation has been granted to the DeForest Wireless Telegraph Company of Canada, with a capital stock of $2,500,000. The head office will be in Toronto. The provisional directors are: Messrs. Alexander McKenzie, E. G. Long, C. V. Bennet and W. H. Templeton, all of Toronto.

Mr. John A. Manly, of Grand Forks, B.C., announces that he has interested American capitalists in a large mining and railway project involving an expenditure of over $4,000,000 in the Boundary district of British Columbia. He states that work will be commenced this summer to develop 2,000 horse power on the Kettle river, seven miles below Grand Forks.

Prof. Loudon, of the department of physics, Toronto University, has invented a photometer for measuring the illuminating power of gas or electric light. Tests of the apparatus have been made by Dr. Johnston, electric light inspector, and Messrs. Donald McPhie, of Hamilton, and James Pape, of Toronto, gas inspectors, with satisfactory results, they reporting it to be extremely sensitive to variations of intensity.

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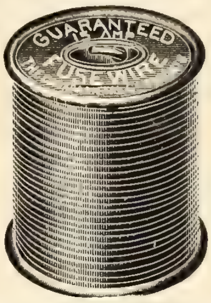

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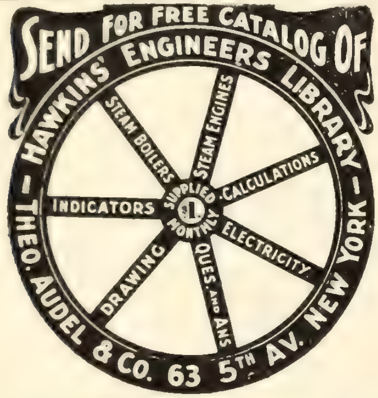

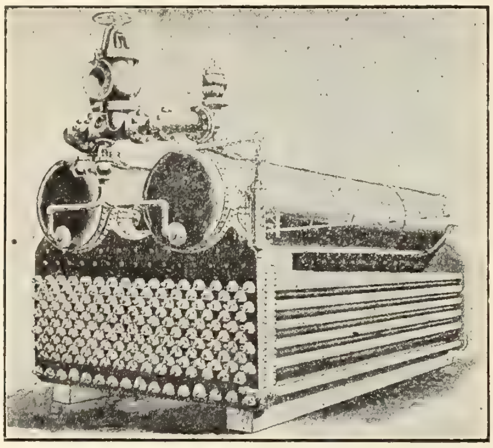

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John Starr, Son & Co., Limited, P. O. Box 448 HALIFAX, N.S.

SPARKS.

The citizens of Benmiller, Ont., are talking of installing an electric light plant.

The Huron, Bruce & Grey Electric Railway Company are said to have acquired a large portion of the Falls Reserve, with the intention of developing the power to operate the railway.

The Sylvester Feed Company, Limited, of Victoria, B. C., are erecting a new building in that city, in which they will install an electric elevator and electric power machinery for the grinding of grain. Messrs. Hooper & Watkins are the architects of the building.

The tender of the Northey Company, of Toronto, has been accepted for supplying a 1,000 horse power condensor for the electric light plant at Edmonton, N.W.T.

Some interesting experiments in connection with wireless telegraphy were recently made at McGill University, Montreal. The idea in course of development is the laying of a cable along the centre of narrow ship channels. Vessels navigating them would be equipped with special instruments, which, as soon as a vessel got a certain distance away from the cable, would ring an alarm. The experiments are said to have demonstrated the feasibility of the idea, and it is understood that a practical test will be made on the St. Lawrence ship channel this spring.

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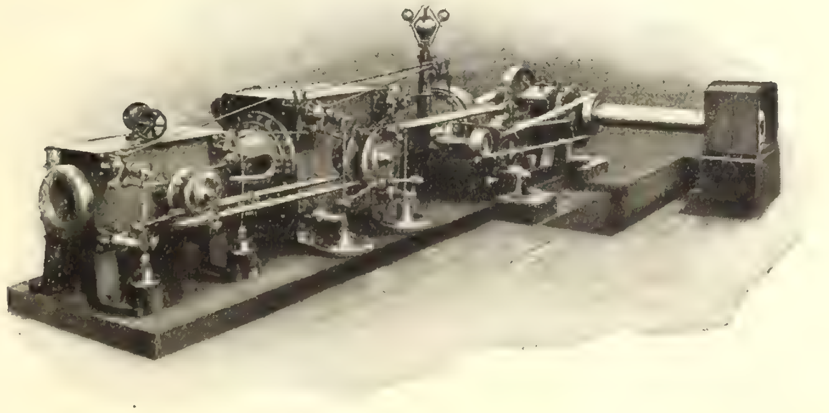

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The Jenckes Machine Co.

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Sherbrooke, Que., Canada

SPARKS.

Incorporation has been asked for by the Dominion Institute of Amalgamated Engineers.

The town of Liverpool, N. S., is about to install an electric light and power plant, tenders for which are invited by the Mayor up to April 15th.

It is understood that the power house of the Niagara Falls Park & River Railway at Niagara Falls, Ont., will be enlarged this spring and new dynamos installed.

Citizens of Havelock and Norwood, Ont., are talking of forming a company for the purpose of developing the water power of the Crow River to light the two villages.

The Bryan Manufacturing Company, of Collingwood, Ont., have installed an electric light plant in their factory, consisting of a 125 light dynamo and a hight speed engine.

A special general meeting of the shareholders of the Humber Power & Light Company was held at Toronto Junction on March 21st, to secure the endorsation of plans adopted by the directors for the completion of the plant at the Humber and providing also for the installation of an auxiliary gas or steam plant. Mr. John Scott, electrical engineer, was present and stated that he had made a personal inspection of the plant and considered that there was a bright future for the company.

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SPARKS.

Mr. Joseph Dogie, of Marbleton, Que., purposes putting in an electric light plant to supply Marbleton, Line Ridge and St. Adolphe.

Mr. C. J. Higgins, local manager of the Bell Telephone Company at Perth and Smith's Falls, has accepted a promotion under the same company at Calgary, N.W.T.

The Bell Telephone Company will build two long-service systems in the West this year, one from Lethbridge to Cardston and the other from Calgary to Edmonton, N.W.T.

It is said that the Canadian Pacific Railway Company have decided to install an electric light plant in the round house at Owen Sound, Ont., with the idea of doing away entirely with gas.

The Westinghouse Air Brake Company are about to commence the erection of a new foundry, to be 320x65 feet and constructed of brick with steel frame. It will be located at Wilmerding, Pa.

Sudbury capitalists are asking for the incorporation of the Sudbury, Copper Cliff and Creighton Electric Railway Company. It is proposed to construct an electric railway connecting Sudbury with Copper Cliff and the Creighton Mine.

Messrs. Verity, Limited, of London, Eng., have sent us a copy of their latest extensive catalogue of electrical machinery and supplies. By an ingenious arrangement provision is made o bind future supplements as a part of this catalogue.

Messrs. Clarke, Cowan, Bartlett & Bartlett, barristers of Windsor, Ont., have given notice of application for incorporation of a company to construct an electric or steam railway from Hamilton to Collingwood, Wellington, Dufferin and Simcoe.

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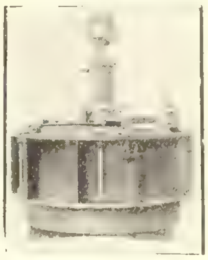

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SPARKS.

The Humber Power & Light Company, of Toronto Junction, is installing a private telephone system connecting the power house with the office and the superintendent's house

The Merchants' Telephone Company, of Montreal, is said to have passed into the hands of a new company, represented by Mr. Arthur Johns, of New York. The exchange will probably be reconstructed on the automatic system.

The farmers in the Slate River Valley, near Fort William, Ont., are formulating plans for a telephone system. It is proposed to construct a local system in the township of Paipoong, where it is thought fifty telephones could be placed, and eventually to connect Fort William and Port Arthur.

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PERSONAL.

As an expression of the esteem in which he is held, the students in the electrical engineering classes of the Toronto Technical School presented Mr. Chas. M. Peake, the instructor of the class, with a beautiful cathedral chime mantel clock.

Mr. John S. Plaskett, B. H., electrician and mechanical expert of the University of Toronto, has been appointed to the position of mechanical superintendent of the new astronomical observatory now in course of erection at Ottawa. Mr. Plaskett is a graduate ot Toronto University as well as an expert machinist, having served five years under Edison.

Mr. Thomas Merry, who for several years filled the position of chief engineer of the Toronto Railway Company, has tendered his resignation to undertake important railway work in the Yukon in the interests of Mackenzie & Mann. Mr. Merry was presented with a gold chain and locket, the latter suitably engraved, by the employees of the power house, also with a gold watch by the Sergant's Mess of the 48th Highlanders.

The municipal building at Fort William, Ont., was destroyed by fire on March 10th. The building contained the newly installed telephone plant which was completely destroyed.

Messrs. Kidd & Thompson, of Ottawa, have applied for the incorporation of a telegraph and telephone company, with a capital of $2,000,000, and power to construct lines throughout Canada.

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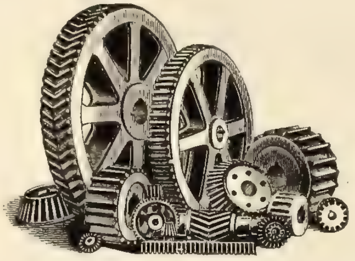

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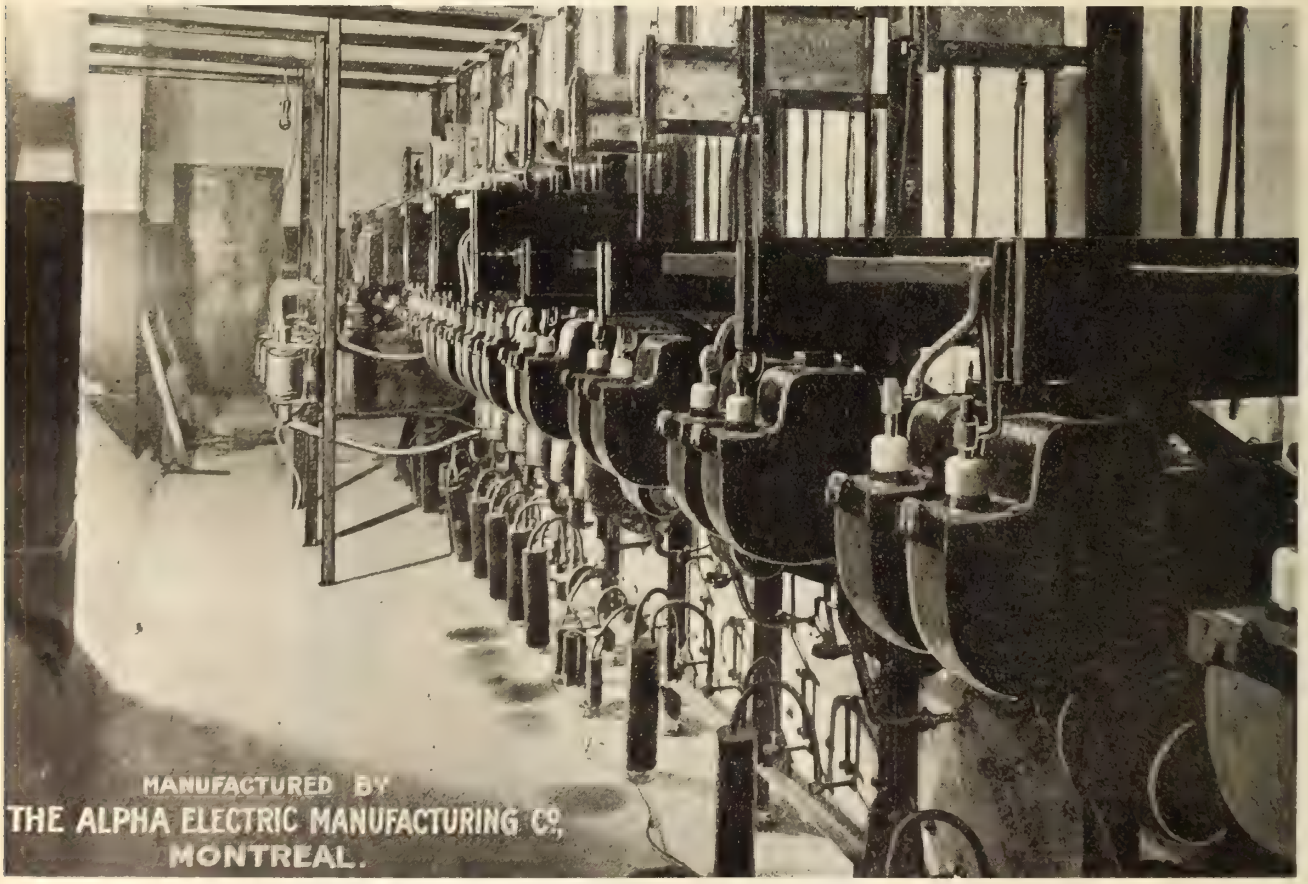

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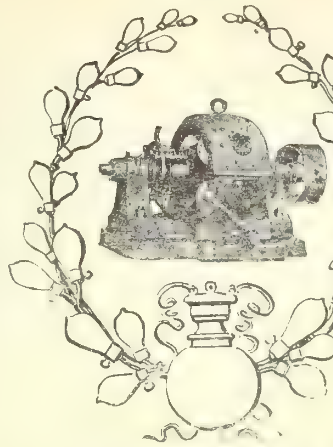

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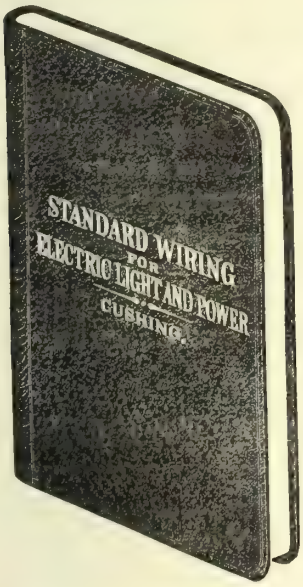

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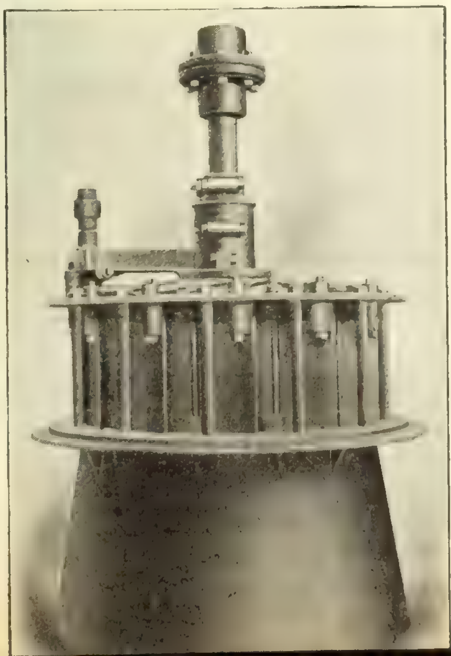

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Electrical News
AND ENGINEERING JOURNAL

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TORONTO, CANADA, MAY, 1903
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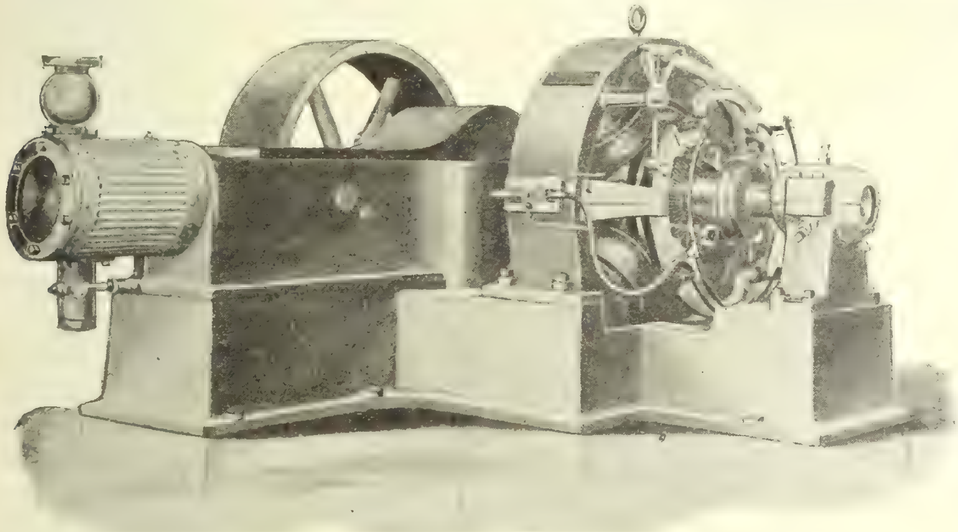

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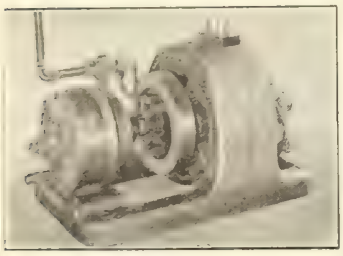

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The control is automatic, there is no fluctuation of light.
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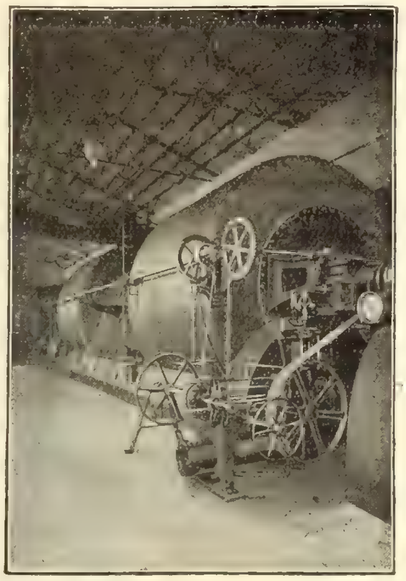

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The Goldie & McCulloch Co., Limited,
GALT, ONTARIO, CANADA

Recently received the following unsolicited testimonial, which speaks for itself :

TORONTO, Aug. 6th, 1902.

THE GOLDIE & McCULLOCH CO., GALT, ONT.

DEAR SIRS :—In our recent fire which, as you know, was a total wreck, and of which we are sending you a photo by this mail, we had two Goldie & McCulloch safes in which we kept all our books. They have come through the fire in remarkable shape and we feel that our praise for your safes cannot be great enough. This fire was an extremely hot one, the locality in which these safes were being surrounded by hay and grain as well as large quantities of packages, barrels and boxes. We might say that everything was burned to a crisp, heavy iron being twisted and melted into frightful shape. We had almost given up all hope of being able to get the books and documents from the safes in such a manner as to make them of any use to us, which we can assure you would have been a very serious matter. We were agreeably surprised, however, on reaching them. While we found the safes somewhat warped and bent on the outside, yet all our books and documents came out in such a manner that we can get everything from them all right. This without a doubt was an extremely hot fire, and the way in which they came through it leaves no room for question as to the manner in which they are made and the stuff they are made of.

Again congratulating you on the safes you turn out and trusting we will have the pleasure of purchasing from you when we again rebuild, as we know of none better, we are,
Yours truly,
P. McINTOSH & SON.

CATALOGUE AND ANY OTHER INFORMATION ON APPLICATION.

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WHEELOCK ENGINES, IDEAL ENGINES, GAS AND GASOLINE ENGINES, BOILERS, PUMPS, WATER WHEELS, OATMEAL MILL MACHINERY, FLOUR MILL MACHINERY, WOLF GYRATORS, WOOD-WORKING MACHINERY, SHINGLE MACHINERY, HEADING AND STAVE MACHINERY, WOOD RIM SPLIT PULLEYS, IRON PULLEYS, SHAFTING, HANGERS, GEARING, COUPLINGS, FRICTION CLUTCH COUPLINGS, FRICTION CLUTCH PULLEYS, SAFES, VAULTS AND VAULT DOORS.

SPARKS.

Work has been commenced on the construction of an electric railway from London to Lambeth, Ont., the promoters being the Southwestern Traction Company.

Mr. C. W. Chadwick, of Rat Portage, Ont., has offered to dispose of a water power which he owns to the city of Winnipeg, claiming that power can be produced at this location at $20 per horse power per annum.

The Chatham, Wallaceburg & Lake Erie Railway Company propose to build an electric road connecting Chatham, Wallaceburg, Petrolea and Blenheim. Messrs. J. N. McKendry and Frank Denton, of Toronto, are interested.

The New Brunswick Telephone Company, which recently built an entirely new exchange at St. John, N.B., have found it necessary to make a small increase in rates, which are now $40 for business and $23.50 for residence 'phones.

Mr. William Robinson, who recently returned from Costa Rica, is endeavoring to form a company to build an electric railway in Owen Sound, with extensions to Meaford and the King's Royal Park. He is backed by Philadelphia capitalists.

The municipal council of Wetaskiwin, N. W. T., has passed a resolution in favor of establishing a system of telephones and fire alarms to be owned exclusively by the town, the charge for telephones to be not more than $15 per annum for business places and $10 for private residences.

Messrs. J.E. Steward, J.E. Porter, G.G. Porter, H.D. Stevens and C.C. Harvey have applied to the New Brunswick Government for the incorporation of the New Brunswick Electric Power Company, capital $40,000. It is proposed to develop a water power near the mouth of the Aroostook river.

Messrs. Steinhoff & Gordon, of Wallaceburg, Ont., have submitted a proposition to furnish electric light for the village of Tweed, which proposition has been accepted. An all-night service will be furnished at the same rate as was formerly paid for the shorter service, with the exception that 25 per cent. additional will be charged for three months of the year. It is intended to install the plant immediately and if possible to utilize a neighboring water power.

The Electro-Manganese Company have applied to the New Brunswick Government for incorporation, with a capital stock of $1,500,000. The applicants are Messrs. B. E. Kingman, of New York, F.C. Sayles and R. W. Sayles, of Providence, and Matthew Lodge, of Moncton. Messrs. Barnhill & Sandford, of St. John, are the solicitors. It is proposed to establish extensive reduction works at Grand Falls, on the St. John River.

An interesting shipment of large steam turbine machinery has recently been made from the shops of the Westinghouse Machine Company, Pittsburg, Pa., which will be the first turbines of a large size and of American manufacture to be exported from the United States. The shipment consists of two-1000 k.w. Westinghouse turbine generating units of the most recent design. They are destined for light and power service in the De Beers mines at Kimberly, South Africa.

The Ottawa Electric Company were heavy losers by the recent fire in the Rochesterville section of Ottawa. The lines through the burned area had only recently been rebuilt in the most modern style. The poles, wires and transformers comprise the chief items of loss. The Bell Telephone Company's loss by the fire is in the neighborhood of $3,000, and that of the Ottawa Street Railway Company $3,500, made up chiefly by the destruction of the company's Somerset street bridge.

Members of the Quebec Colonization Commission have submitted to the Lieutenant-Govereor-in-Council a memorandum dealing with railway development in that province. The Committee are in favor of electric roads, concerning which they say: "Would it not be, from all reports, an advantage to substitute electric roads for steam roads, especially in the parts where the traffic is essentially local. These roads, so easy of construction and costing so little to work, could advantageously precede the colonist in the forest, to procure him the means of comfortable transportation at small expense. Besides being better adapted to rough and mountainous countries, the electric roads are less expensive to construct, and give much more accommodation to the public, in the sense that the running of trains is more frequent. There is no country so well situated as the Province of Quebec in all which concerns electric roads, for we have water power capable of furnishing practically an unlimited quantity of motive power. The time has arrived to use this resource for procuring to the province this excellent means of transportation."

Dodge Standard Wood Split Pulleys
Increased Profits Because of Economical Power Transmission

Every Pair of Hands Tell Their Own Story.

This pair does not require a palmist to interpret their message.

Look into the hands of every user of Dodge Wood Split Pulleys, and you'll find the proof of increased profits.

That's because the Dodge Wood Split Pulley weighs but one-third as much as iron pulleys of equal size—consequently less coal consumption to drive your shafting.

Because Dodge Wood Split Pulleys can be placed in much less time, at any point on your line without disturbing the shafting, consequently less money for installation.

Dodge Wood Split Pulleys are perfect for economical power transmission.

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Power Transmission Engineers.
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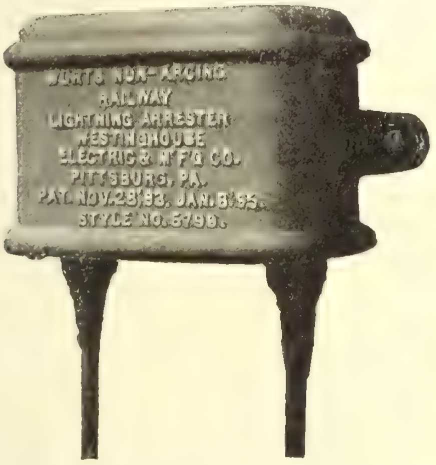
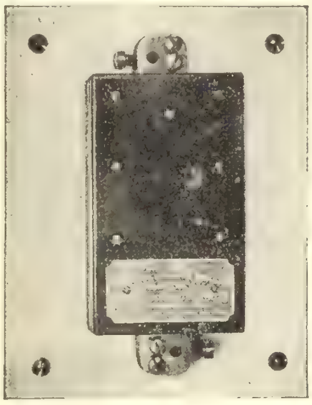
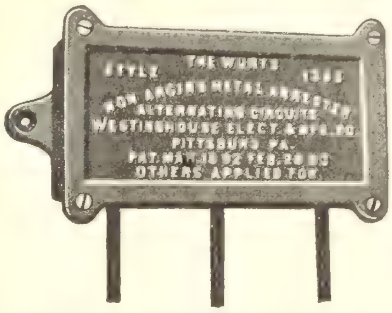
Westinghouse Lightning Arresters



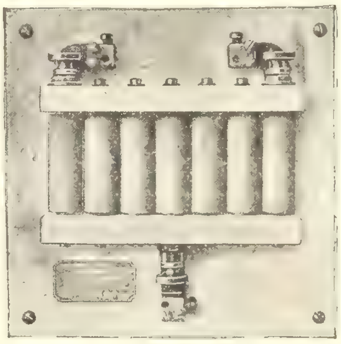
Type L Railway Arrester, Direct Current.



Type I Station Arrester, Direct Current.



Type C Line Arrester, Alternating Current.



Type A Station Arrester, Alternating Current.

Built to protect all kinds of electrical apparatus, at a cost insignificant as compared with the value of the protection.

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OTTAWA, CANADA.

Type "R"
Packard Transformers

Packard type "R" transformer offers to central station managers a transformer having high insulation, low and uniform temperature rise, low core loss, good regulation—features which have a direct bearing in the profits of every lighting and power plant.

In type "R" the insulating is by mica troughs—the use of which, owing to its expense, has heretofore been restricted to special transformers for high voltages.

This gives to type "R" the best insulation and coolest operation of any transformer on the market.

The Packard Electric Co., Limited
Montreal St. Catharines, Ont.

Makers of Lamps, Transformers, Meters, Hylo Lamps.

Our transformer catalogue is now in press. We shall be pleased to send you a copy upon issue. -:- -:- -:- -:- -:- -:-

PERSONAL.

Mr. F. D. McCormack, of the General Electric Company's Toronto staff, is at present visiting in Europe.

Mr. A.M. Wickens, chief engineer at the Parliment Buildings, Toronto, is reported to have tendered his resignation.

Mr. William Reese has been appointed engineer at the power house of the city of New Westminster, B. C., as successor to Mr. W. A. Robertson, who resigned.

Mr. W. H. Breithaupt, late manager of the Berlin Electric Light Company, will engage in practice as a consulting structural engineer. Mr. Breithaupt is a member of the American and Canadian Societies of Civil Engineers.

The many friends of Mr. J. J. Wright, manager of the Toronto Electric Light Company, will be pleased to learn that he is now on the way to recovery from the very severe illness which has laid him aside from business for the last two months.

Mr. R.S. Kelsch, general superintendent of the Lachine Rapids Hydraulic & Land Company, Montreal, was recently presented with a loving cup bearing an appropriate inscription by the heads of the various departments over which he has charge.

The engagement is announced of Mr. Herbert Henley, formerly of Toronto, but now engaged with Sir John Aird & Sons, contractors in connection with the electrification of the London, Eng., United Tramways, and Miss Cecily Green. The wedding will take place at St. Mary's church, Stamford Brook, on June 10th.

It is announced that Mr. W. H. Moore has been appointed to the important position of assistant to Mr. William Mackenzie, president of the Toronto Street Railway Company. Mr. Moore has for several years been closely associated with Mr. Mackenzie in connection with the management of this railway.

Mr. A. M. Stark, for many years in the employ of the Bell Telephone Company in Toronto, and latterly local superintendent, has resigned his position to exploit his patent on an invention to supply telephone communication, power and light over the same circuit. This invention was described in the March Electrical News.

Mr. A. G. Sangster, who for nineteen years has been assistant superintendent of the Sherbrooke Power, Light & Heat Company, Sherbrooke, Que., has severed his connection with the company to accept the position of superintendent of the St. Francis Hydraulic Power Company. The latter company has recently been organized to supply light and power to the mining districts of Black Lake and Thetford Mines, Que.

It is gratifying to learn that Mr. A. W. Trenholm, who has recently been appointed general manager of the Chicago, St. Paul, Minneapolis & Omaha Railway Company, is a Canadian. He started in business life with the Intercolonial Railway, and after filling a subordinate position in the audit office at Moncton went to St. Paul, where he steadily advanced from a telegraph operator to his present responsible position.

SPARKS.

New street lamps have been installed by the St. Johns Electric Light Company, of St. Johns, Que.

The Winnipeg Street Railway Company have ordered a number of large 40-foot vestibule cars and are building a number of 45-foot open cars for the summer traffic.

The Warren Electric & Specialty Company, of Warren, Ohio, has been authorized to manufacture electrical apparatus in Ontario, the capital of the provincial company being $50,000.

The Walsh improved double acting water wheel governor is highly recommended where an inexpensive and accurate regulator is needed for ordinary requirements. This regulator is manufactured by J. C. Wilson & Company, Glenora, Ont., and among their recent customers are Messrs. Geo. Pattinson & Company, woolen manufacturers, Preston, Ont., and W. J. Sutton, Victoria, B. C.

Direct Connected Generators
For Railway, Lighting and Power

Belt Driven Generators

Multi Voltage System
For Variable Speed Control.

Crane Motors and Controllers

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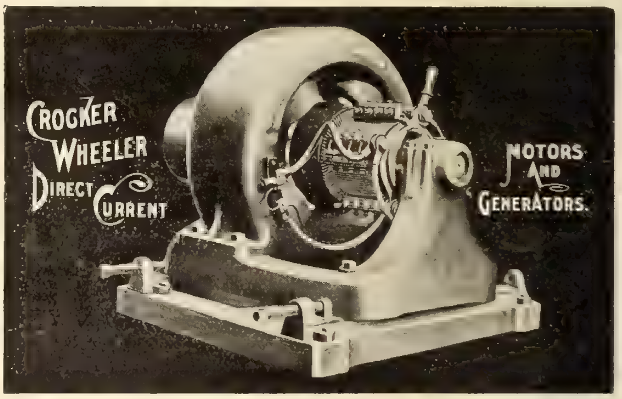

The real test is actual operation. When all has been said, the fact remains that a poor transformer cannot give a service free from burn-outs or other troubles. No trouble with

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The R. E. T. Pringle Company, Limited, Sales Agents

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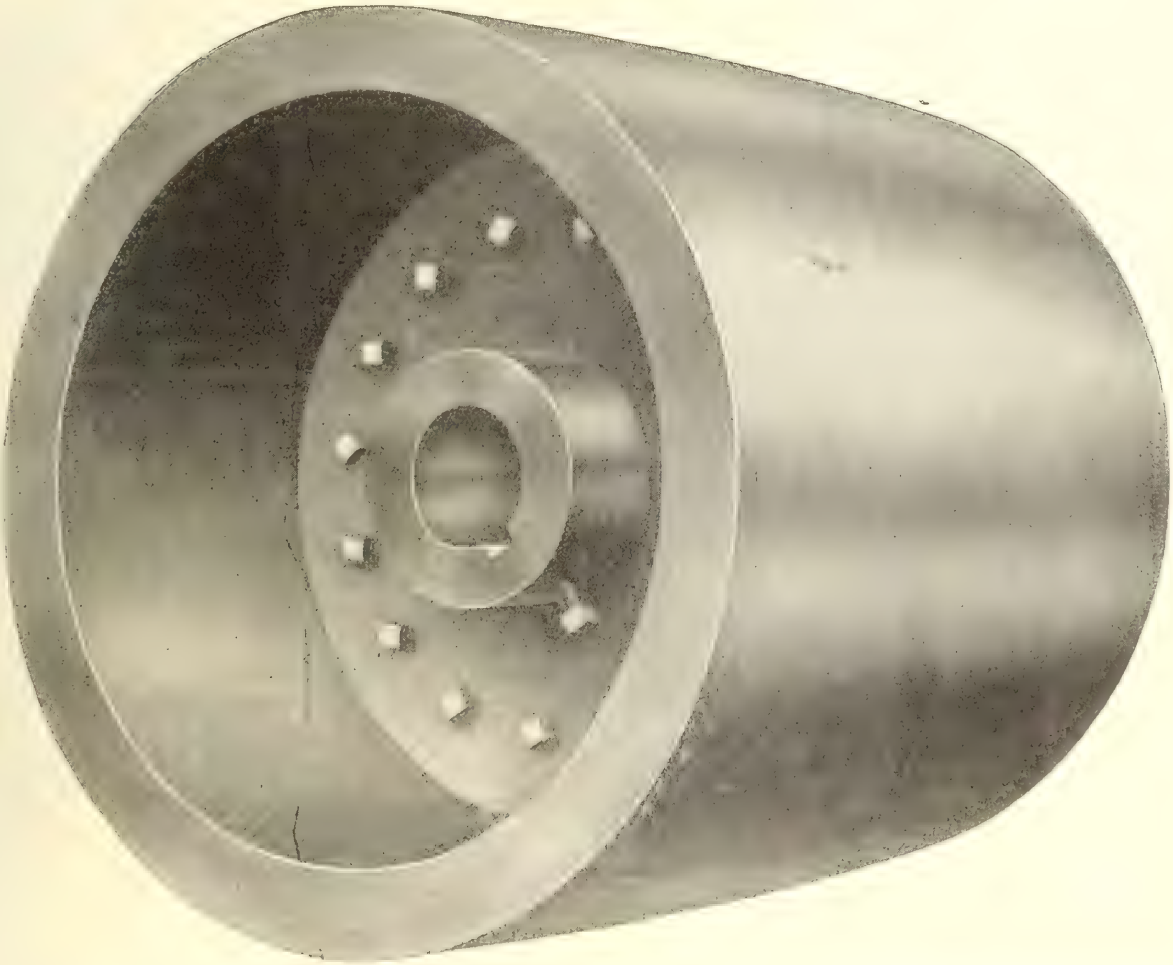

THE ABOVE PHOTOGRAPH WAS TAKEN FROM ONE OF A LOT OF OUR 52½x56x8 XYLOTITE PULLEYS, WHICH WERE THE LARGEST FIBRE PULLEYS EVER MANUFACTURED.

SPECIFY XYLOTITE PULLEYS ON ALL APPARATUS

WE MAKE ALL SIZES. NONE TOO LARGE OR NONE TOO SMALL.

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Motors and Generators

Up to 1000 k. w.

Standard Make.

WATSON JACK & COMPANY

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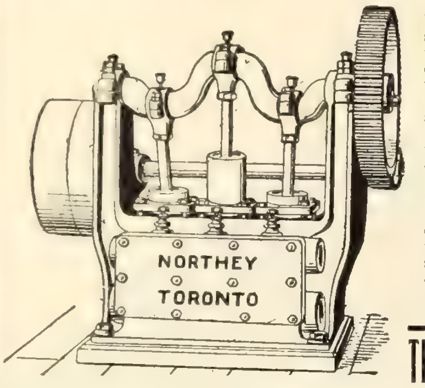
THE NORTHEY TRIPLEX POWER PUMP

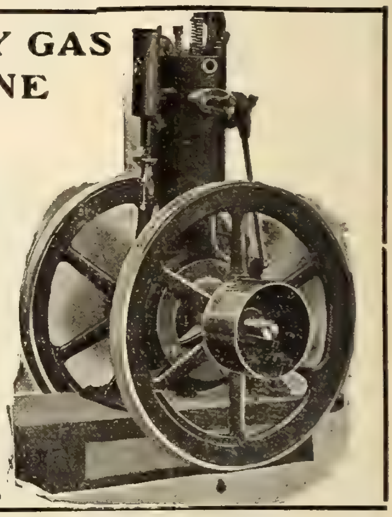


This pump excels in high class materials and workmanship. A practically constant delivery is assured by the three cranks being placed 120 degrees apart. The pump can be operated conveniently by water power—by belt from engine or by electricity.

We manufacture pumps of every description—for all purposes. Our pumps are standard in Canada for excellent service.

Write for Catalogues.

The NORTHEY GAS AND GASOLINE ENGINE

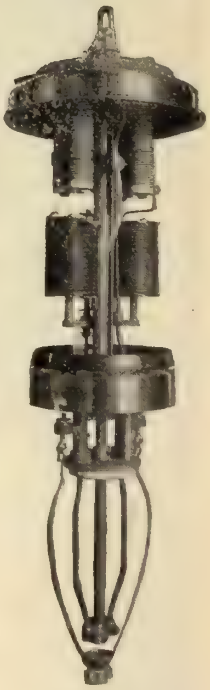


The Northey Gasoline Engine offers the best proposition in the market for cheap, easily handled power. The Engine runs with practically no attention—any boy can manage it—running expenses very light. Ready for work on the minute. Suitable for running independent electric light plants—pumping and elevator plants, etc. This cut illustrates the ½ H. P. size—the only vertical style built; all other sizes are horizontal.

Write for Booklet.

THE NORTHEY CO., LIMITED, 970 King Street Subway TORONTO.

New Helios-Upton Arc Lamps



HAVE
- Simplicity of mechanism.
- Every portion easily accessible by removing outside case.
- Upper carbon holder has an outside cable connection.
- Large inner globe supported from the bottom.
- Porcelain lined inner globe cap.
- Most durable form of resistance.
- Easily trimmed.
- Easily adjusted.
- Steady burner.

JOHN FORMAN

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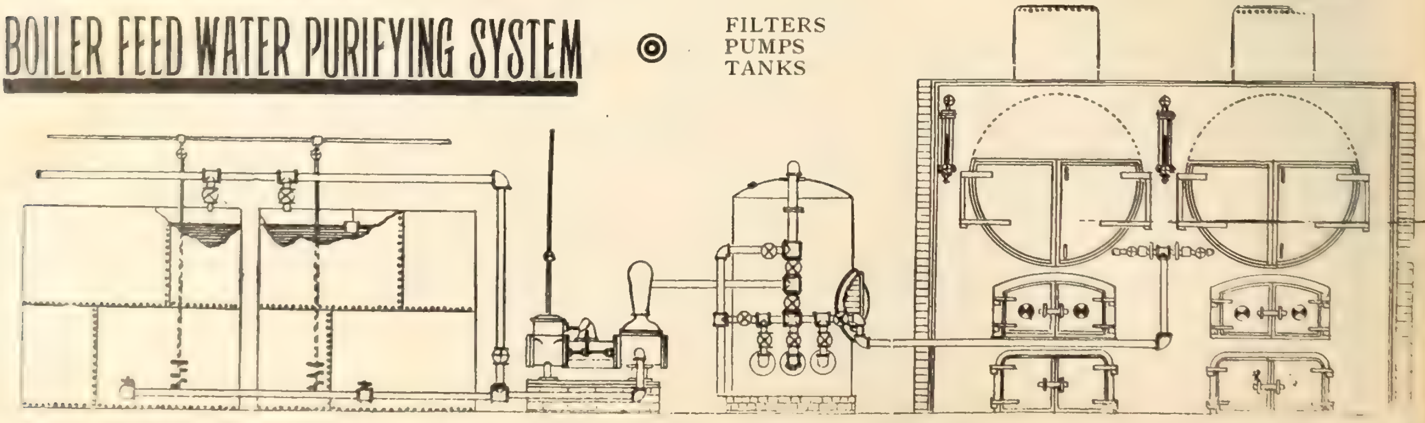
BOILER FEED WATER PURIFYING SYSTEM

◎ FILTERS
PUMPS
TANKS



THE JOHN McDOUGALL CALEDONIAN IRON WORKS, LIMITED, - - Montreal, Que.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIII. MAY, 1903 No. 5.

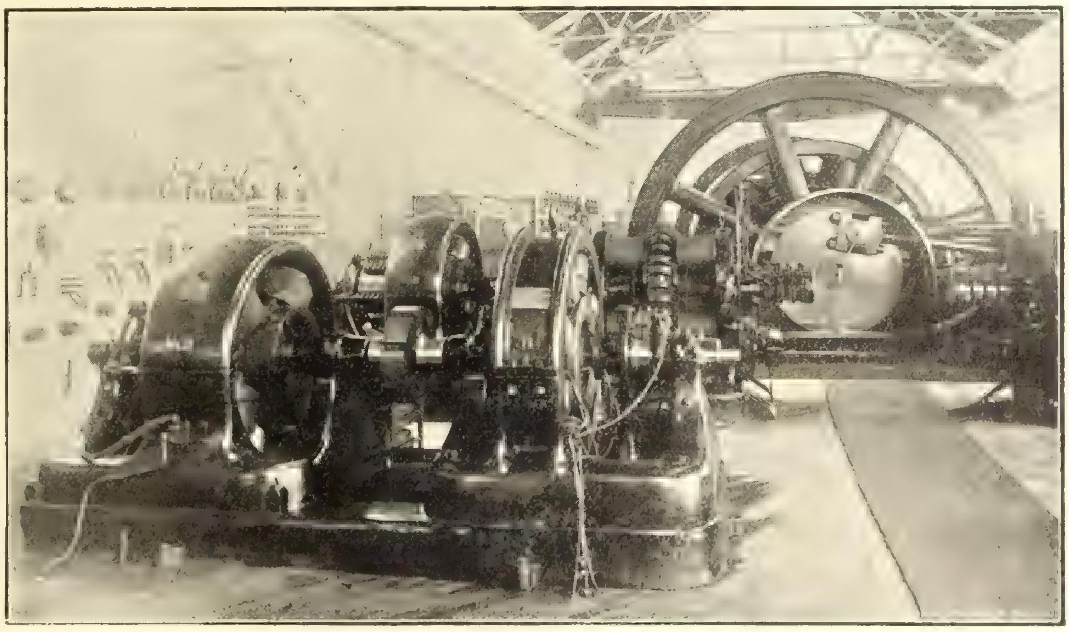
POWER STATION OF THE DOMINION IRON AND STEEL COMPANY.

There are many interesting features worthy of notice in connection with the Dominion Iron & Steel Company's works located in the flourishing town of Sydney, Nova Scotia. It is a rare occasion for visitors to look over these works without being shown through the electric light and power station, where everything is kept in place and shining like a silver dollar. Visitors are invariably informed of the fact that everything in connection with this portion of the works is absolutely of Canadian manufacture—even the building itself, with a Canadian electrical engineer in charge. It was the first department to be completed. The building and machinery were erected within the time limit, and the plant has since been running without even a shut-down, which is certainly a credit to Canadian manufacturers. For the benefit of those of our readers who have not visited the plant the accompanying views are printed.

The gas from the blast furnaces being used for generating steam in place of coal, it became necessary to erect a large electrical station close to the boiler house, and from this station distribute electric power throughout the works for operating all classes of machinery, thus bringing the cost per h. p. down to a minimum. The power station is a modern brick and steel structure, 50 x 150 feet.

The station equipment consists of the following: Three 500 k.w. C.G.E. 250-volt, direct current, direct connected generators, operating at a speed of 90 r.p.m., each being connected to Laurie horizontal, cross-compound, Corliss type engines; three 125 light 4-circuit Brush arc generators, 6.6 amperes each, coupled direct to 90 h.p. 250-volt motors mounted on cast iron bases; two 60 kilowatt C. G. E., single phase alternating current generators, 1000 volts each, coupled direct to 90 h.p. direct current 250-volt motors, each set being mounted on cast iron bases.

The switchboards, which consist in all of 19 panels, are made of blue Vermont marble, equipped with C.G.E. M.Q. circuit breakers, Thomson astatic instruments for direct current, and inclined coil type for alternating work. Separate feeder panels have been laid out for the different departments, each furnished with ammeters, etc. A total load panel has been installed equipped with T. R. watt-meter, which enables them to take readings of total load daily.

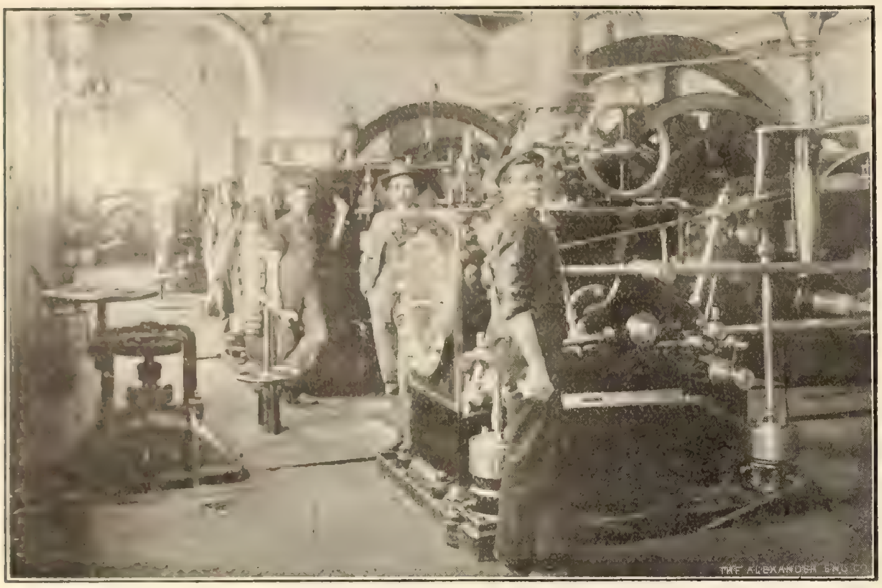


POWER STATION OF THE DOMINION IRON & STEEL COMPANY—MOTOR GENERATOR SETS.

Where arc lamps are required during day time, 250-volt power circuit is used, there having been installed a large number of lamps burning two in series. The Brush arc units are used for the all night service, there being upwards of 300 enclosed arc lamps installed on these machines.

Although these works are not yet completed, there are over 6000 h. p. in motors connected to lines, every possible piece of machinery being electrically driven. A detail description covering this portion of the work was published in the Electrical News of October, 1902, to which the reader is referred.

The trolley system operating the scale cars, the ore bridges, 50 ton cranes, and pushers in the open hearth furnaces is most interesting, and altogether the electric plant is looked upon as one of the most successful branches of the immense industry.



Power Station of Dominion Iron & Steel Company—Engine Room.

The complete power house equipment, lamps, etc., were furnished and installed by the Canadian General Electric Company, Limited, of Toronto, and the engines by the Laurie Engine Company, of Montreal. The building proper was erected by the Dominion Bridge Company, of Montreal.

Mr. W. B. Boyd, E.E., of Toronto, is in complete charge of this important department, and to him we are indebted for the photographs and particulars of the plant.

ELECTRICITY FOR UNDERGROUND HAULAGE.

Replying to a question as to how electricity can be applied to underground haulage, a writer in the Mining Record, of Halifax, N.S., submits the following :

I base my answer on practical observations which have from time to time come under my notice. I will divide my answer into sections which are all essential for the application of electricity to haulage.

(1) The first power.

(2) The dynamo and the motor.

(3) Suitable voltage.

(4) The connection of the motor to the haulage engine.

1. The First Power.—Whether the electric energy required is for the driving of haulage engines, pumps, coal cutting machines, or any other plant, it will first be necessary to have the initial or first power to drive the dynamo, which may be either a steam engine, water wheel, oil engine, or some other source of energy.

Generally speaking, we find that a steam engine is applied which necessitates the application of boilers for the raising of the steam.

The steam engine for dynamo driving that should be appreciated is one that is economical in running, not liable to break down, and one in which repairs can be easily executed at a small cost.

There are three distinct kinds of engines that have been applied, viz., the high speed engine coupled direct to the dynamo, the slow speed engine with rope or belt driving, the steam turbine coupled direct.

I have known each of these systems in practice, and each claims advantages under different conditions of working.

The first type of engine is a compact one and works extremely well where the load is even, the first cost being high. The greatest disadvantage of it is that the shock and strains are transmitted directly from the dynamo to the engine and vice versa.

Generally we find that haulage loads vary a great deal, most especially where the main rope and main tail rope systems are adopted.

The second type of engine and dynamo is certainly not so costly at first as the direct coupled engine, but the secondary cost is high by reason of a large engine house having to be made, and foundations for the same. These engines run very smoothly, and owing to the electricity of the ropes or belt gearing the shock on the engine and dynamo is not great, consequently very little wear and tear is caused, which means a great saving in repairs.

Power Station of Dominion Iron & Steel Company—Switchboard.

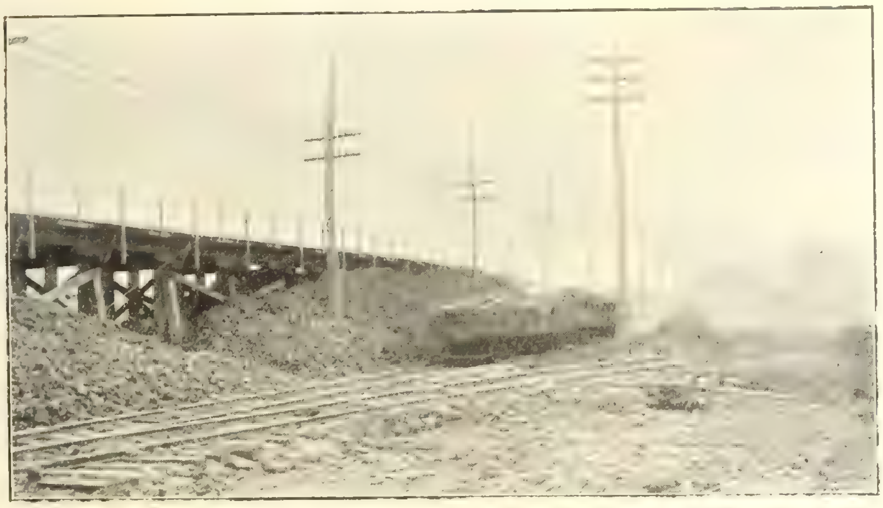
The third type of engine and dynamo does not require much room, as it is coupled direct. It is very quick running, and varies exceedingly little no matter what load is being conveyed.

The second type of engine has my preference, as it has given general satisfaction.

The Dynamo and the Motor.—I now come to the classes of dynamos that have been and are now used.

There are two divisions into which this machinery is divided, viz., the alternating current and the direct or continuous current.

The alternating current machines are periodic, being reversed in direction many times a second, the number of complete changes being known as the frequency of the current. These are divided into two main classes, viz , single phase (where only one current is generated), and two or three, or polyphase machines (two or more currents of equal frequency). Motors of this class have neither commutators nor brushes, nor wires on the revolving part, but simply two collecting rings for making connection with external circuit.



Power Station of Dominion Iron & Steel Company—Pole Line Leading to Open Hearth.

Continuous Current Machines.—The continuous current machinery has almost exclusively been used up to late, but now we find the alternating current system coming more in favor for underground use, most especially in fiery mines where sparks are a source of great danger. These continuous current machines are divided into three principle classes, and are in general self-excited machines—that is, the field magnetism is produced by the machine's own current—according to the manner in which the field magnets are wound, so that they may be energized by the whole current, a derived part of the current, or a combination of the two arrangements. The classes they are known by are as follows: (1) Series wound machines; (2) shunt wound machines; and (3) compound wound machines.

Both these systems (alternating current and continuous current) have been employed for underground haulage. I have known both main rope, main and tail rope, and endless rope haulage, driven by the shunt wonnd and series wound systems, and I consider that the series wound is the best system for the two former modes of haulage, and the shunt wound system for endless rope haulage; and for an underground fiery mine I prefer the polyphase system in preference to the continuous current system.

Suitable Voltage.—The commercial voltage used for underground purposes has varied a great deal, depending on the conditions under which the electrical machinery is to be run, but a practical voltage (electrical pressure or electro-motive force, that is, the pressure that is required to send one ampere through a resistance of one ohm) of 400 to 560 meets the safe and economical requirements; higher pressures have been known to cause great shock in the cable and damage to the insulation of the dynamos and motor.

The Connection of the Motor to the Haulage Engine.—This has been done by direct coupling, by spur gearing, by worm gearing, and by rope and strap connection. The rope and strap connection has had many advantages, and is worthy of such appreciation, as it prevents jerks and shock to the machinery, and consequently gives a longer life to such machines.

Some prefer to have the generating station at the surface, whilst others prefer the dynamo fixed underground.

It is better to fix the dynamo on the surface and convey the cables down the shaft, than to carry a large column of steam pipes down the mine to drive the dynamo. The following is a description of an electric plant which has been erected by Messrs. Scott and Mountain, supplying a current and conveying the same 2,000 yards from the generation at another station at one colliery to work the underground haulage gear at another mine a distance of one mile from the shaft:

A vertical two-crank enclosed compound self-lubricating engine of 350 horse-power, and coupled direct to a 200 kilowatt, six pole dynamo of the continuous current type, the motor for driving the haulage gear being 200 horse-power, and connected by a strap arrangement from the motor to the gear, which is to drive several branches on the endless rope system.

TWO CURRENTS ON ONE WIRE.

At a recent meeting of the Cornell Electric Society at Ithaca, N.Y., Prof. Frederick Bedell, of the physics department of Cornell University, announced a new discovery in electric power transmission, whereby an alternating and a direct current may be sent at the same time. Experiments show great economy, the amount of copper being reduced one-half.

Power Station of Dominion Iron & Steel Company—
Office of Mr. W. B. Boyd, Chief Engineer.

Messrs. J. R. Booth, of Ottawa, L. A. Barclay, of Whitby, and others desire to be incorporated as the Algonquin Lumber & Power Company, to do a lumbering business, develop power and build and operate railways in the counties of Simcoe, Peel, York and Dufferin and in the Georgian Bay district.

THE CASCADE WATER, POWER AND LIGHT COMPANY.

By W. G. McConnon.

All of the gold extracted from water is not taken directly in the form of metal. A power house for generating electricity proves a very efficient "stamp mill" for delivering "concentrates" in the form of volts. That this is appreciated by mining men is evidenced by the recently completed plant of the Cascade Water, Power and Light Company, situated at Cascade, B. C., and owned by the London and British Columbia Goldfields Company, Limited, representing an investment, in round numbers, of $500,000.

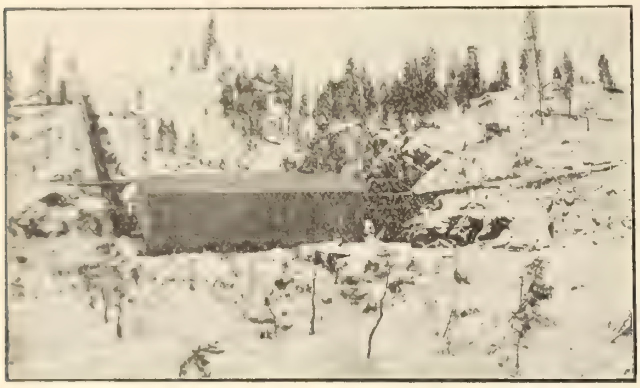


Fig. 1.—Exterior of Power House, Showing Pipe Line.

Cascade is a small town on the Kettle river, twelve miles east of the town of Grand Forks, and about thirty miles directly west from Rossland. Flowing from the west, the Kettle river descends 120 feet in passing through a half mile of narrow rocky gorge in a series of rapids and falls. For the utilization of this natural power, the Cascade Water, Power and Light Company has built a large dam, waterway, pipe line, power house and transmission line from Cascade to Phoenix, where the largest and most productive copper mines in the "Boundary District" are situated.

The dam, placed just above the entrance to the gorge, is of timber cribwork, with a 40-ft. base and 24-ft. top. The mid-section is 50 feet high, tapering to 25 feet at the sides, while the total length is 400 feet. This is built on a solid rock bed to which the foundation timbers are bolted and filled with 10,000 cubic yards of rock. This dam raises the water 36 feet above the natural level, giving an effective head at low water of 156 feet.

The permanent water level is 10 feet below the top of the dam, being controlled during high water by twelve sluiceways which can be opened to 12 feet below the natural river level, giving a passway of about 2,000 square feet. These sluices are closed by means of 12 x 12 in. squared timbers in grooves, operated by a travelling winch running on a track over the top of the dam.

From dam to power house the water first passes through a 225-ft. open rock cut from which it enters a tunnel driven through 410 feet of solid rock, passing under the track of the Canadian Pacific Railway, and then into another open rock cut 500 feet in length, at the end of which the bulkheads and controlling gates are located. These cuts and tunnel, representing an excavation of about 35,000 cubic yards of rock, are of dimensions liberal enough to avoid any appreciable loss of head, delivering the water with a head almost equal to that at the dam level.

From the gates the water is conveyed through a wooden pipe, 7 feet in diameter, for about 1400 feet. This pipe is constructed of Oregon fir tongued and grooved staves 2¾ inches x 7 inches, cut in circular segments and machined to the radius of the pipe. The staves are hooped at 12 in. intervals, with ¾ in. round steel bands, with cast iron connecting shoes for clamping.

Provisions have been made at the bulkhead and in the width of the cut for the installation of a similar and additional pipe.

From the stave pipe the water is carried through 250 feet of circular steel pipe, 7 feet diameter, resting on concrete piers and anchored into solid rock to avoid end thrust. Where this pipe passes alongside of the power house, three 4-ft. pipes and one 2-ft. pipe are taken off below the floor level of the power house to supply three 36-inch turbines for generators and two 12-inch turbines for exciters.

Fig. 1 is a general view of the power-house showing the stand pipe at the junction of the stave and steel pipes. This stand-pipe relieves the pipe line from excessive water-ram strains, and incidentally avoids any air taken into the pipes.

About 10,000 cubic yards of rock were removed for the site of the power-house, in a natural bay at the foot of the falls. This building is of substantial fireproof construction, 150x50 feet, with stone foundation 22 feet deep on the lower side, and brick walls 30 feet above floor level, the height to peak of roof being 45 feet. It has been designed with a view to lengthening it when required.

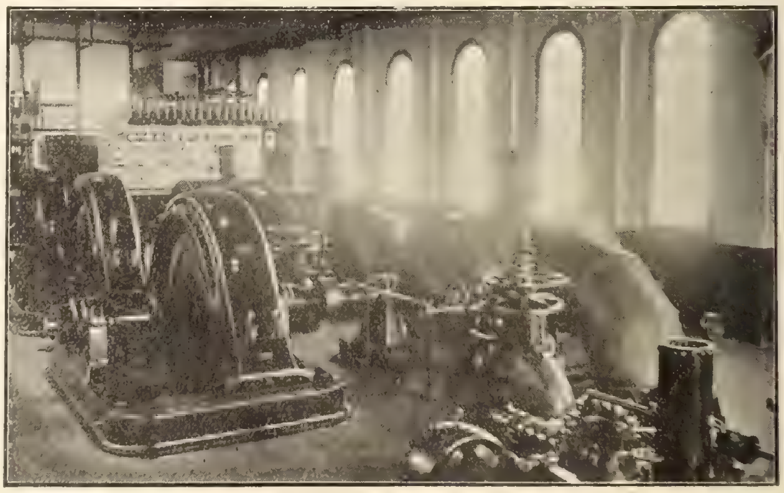


Fig. 2.—Interior of Power House, Showing Generators.

Fig. 2 shows the interior of the power house and the generating plant. The three generators are standard Westinghouse, three phase, two-bearing, direct-coupled, 2200 volt, 750 k. w. at 80 per cent. power factor, or 940 k.w. at 100 per cent. power factor, 60 cycles per second, 300 r.p.m. The two exciters, each capable of exciting all three generators at one time, are 45 k.w., 120 volt, shunt wound dynamos, self-contained, two-bearing type, direct coupled to independent turbines, with 500 r.p.m. The turbines are S. Morgan

Smith wheels made at York, Pa., and the governors the Esher Wies make from Switzerland.

Fig. 3 shows the transformers, nine in all, three in each bank, which are standard Westinghouse, self-cooling, oil-insulated type, having a capacity of 250 k.w. at 80 per cent. power factor, or 312½ k.w. at 100 per cent. power factor, "Star" connection, and wound for a ratio of 2,000 to 20,000 volts, on both high and low tension windings, with full load efficiency of 97.6 per cent. As the taps are brought out near the neutral point, which is grounded, it is impossible to maintain a dangerous voltage in the auxiliary circuit.

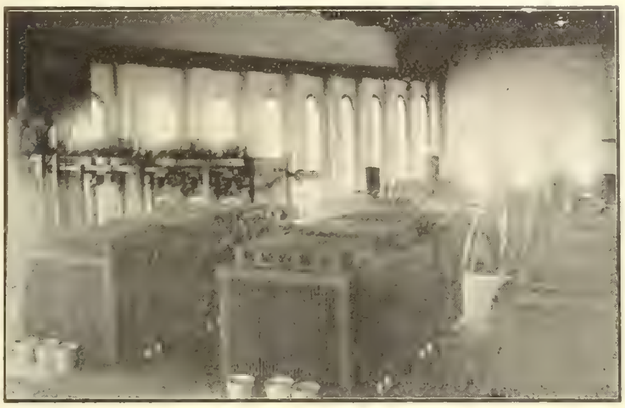


Fig. 3.—Transformers in Power House.

The current from the high tension side of the transformers is carried to a row of high tension fused circuit-breakers, situated alongside of the building behind the main switchboard, as shown in Fig. 3. These switches are of the well-known Westinghouse type, placed on independent marble slabs, with marble barriers between. The current leaving these switches enters a high tension bus and is carried to the line switches at the rear of the building. These line switches are grouped switches opening all three wires at the same time. Each switch is furnished with a time limit tripping device and reversed current tripping coils, so that overloads can be carried for a period of from one to ten seconds, as the local conditions call for, or either line can be cut out automatically in case of trouble.

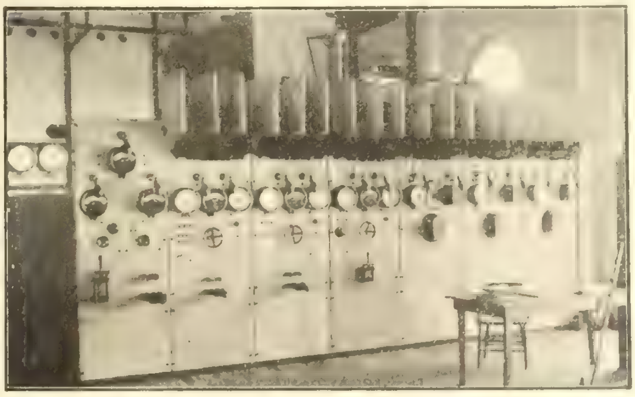


Fig. 4.—Switchboard in Power House.

The switchboard for the low pressure side, Fig. 4, consists of seven panels of blue Vermont marble, one panel for each generator, one for the two exciters, and a feeder panel for each group of transformers.

The six lightning arresters, located just above the switches in the gable of the roof, are the "Low equivalent" style of the Westinghouse Electric & Mfg Company, giving protection against lightning discharges for transmission at 20,000 volts.

A right of way 132 feet wide is cleared, and transmission lines erected from Cascade via Grand Forks to Phoenix, a distance slightly over 21 miles.

The high tension circuit consists of two separate three-phase transmission lines, each carrying three No. 3 B. & S. copper wires, with room on each line for another circuit. Throughout it is one of the most substantial and well constructed lines in the Dominion.

The poles are heavy cedar, and on tangents are spaced not over 100 feet apart, on curves at less distances, in some cases as low as fifty feet. No angles are turned, but all changes in direction of line made with easy curves. No side or head guys have been used except at extra heavy spans across rivers, etc.

The work on this line, as well as all construction of the plant, is a decided credit to the company's local engineer, Mr. Wm. Anderson, who has designed and executed the work.

A three-mile feeder is taken off at Grand Forks, twelve miles from Cascade, to the Granby Smelter of the Granby Mining and smelting Company, where current is used for driving Westinghouse induction motors of sizes ranging from three to seven hundred horse-power, and of an aggregate capacity of 2400 horse-power.

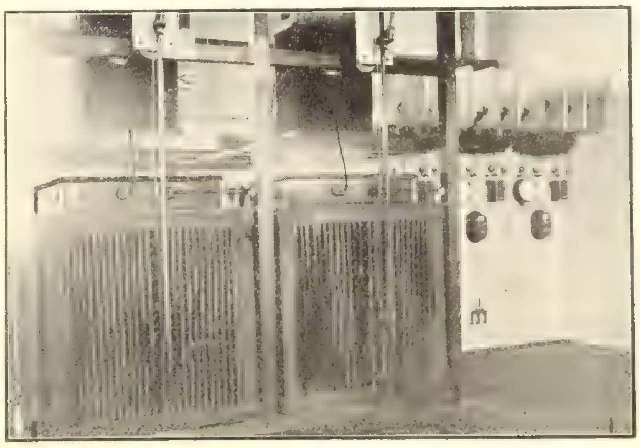


Fig. 5. Interior of Sub-Station at Phoenix.

The sub-station at Phoenix is located at an altitude of about 3500 feet above the power-house. The building is of brick, with one end left for future extension, and contains the transformers, line switches, fused circuit breakers, switchboards, etc., substantially duplicating those at the power-house. Fig. 5 shows the interior of this sub-station, which for the immediate present will be called upon to supply current for two 700 h.p., Westinghouse, type "C" motors for driving two large compressors, a 100 h.p. motor for stone crusher, and a 150 h. p. motor for hoist, as well as furnishing the current for lighting the town of Phoenix.

The Cascade Water, Power & Light Company estimates that it will have a supply, at low water, for about 6200 h.p. This will enable the doubling of the present output. All the plans were made and carried out with the view of extending the plant to its full capacity, and from present indications it would seem that the company will have a demand for all the power it can furnish.

The Town Council of Orillia, Ont., are at present considering plans for improving and extending the power plant at Ragged Rapids.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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High Tension Wiring In a recent paper given before one of the Cleveland engineering societies by Mr. Paul M. Lincoln, of the Westinghouse Company, some interesting points were brought out as to the best method of high tension wiring inside power stations and similar buildings. Practically all modern plants now use some form of cable, insulated with rubber and in most instances protected by a lead sheathing. This, it was pointed out as the author's experience, should be installed on insulators which are designed for the voltage of the circuit of which the wiring forms a part, and thus be capable of controlling that pressure should the cable give way; in fact the cable insulation proper should be looked upon more as a protection against accidental contact than as insulation proper of the circuit. In support of this view several cases were cited in which cables, installed in ordinary racks, had given trouble by breaking down, either at points where they were supported, or else at the end of the lead sheathing. The recent shut down at the Niagara Falls plant might be taken as a warning against the growing tendency to bunch all sorts and conditions of cable into one confined situation where trouble, once started, may find it an easy manner to cause an interruption, more or less lengthy, to the whole service, to say nothing of the possible damage to the equipment.

Street Car Brakes. In the designing of new railway systems, or the adding to plants already in service, it often appears that so much stress is laid on the power to start quickly, that the equally important point of the ability to stop promptly is entirely lost sight of. That this is but too true will be self evident to anyone who cares to observe the operation of the brakes on the great majority of our street railways, where in too many cases it would appear as if that part of the equipment received but scant attention until it was positively unable to do further work. The schedule time, it should be remembered, can be increased by quick and businesslike stops just as much as by fast starts, and further, with less expenditure of power. Nothwithstanding this, many of our systems have cars in service with the shoes hanging at all distances from the wheels, the brake chain and mechanism with two or more turns of slack in them, and the adjustment such that some wheels are sliding long before the balance have anywhere near the proper shoe pressure applied to them. Further than this, the leverages are so proportioned or the mechanism so set that herculean efforts are required on the part of the motorman before he can produce any effect, in addition to which he is sometimes required to do his sanding by means of a shovel. This of necessity means that only one rail is so treated; the results in the shape of twisted trucks and car bodies can easily be imagined. The remedy for all this is careful and frequent inspection and adjusting, and the providing of proper sand devices for both rails, outlays which will soon prove themselves to be fully justified, producing as they do, the power to make a faster schedule and also having a tendency to lessen accidents. Further than this, it is probable that the energy required to operate a car whose braking mechanism is always in good shape will be found to be less than that required if this part of the equipment is entirely neglected, as in the latter case it is found that motormen run with the shoes caught up slightly to the wheels, in order to minimize the time required to set them for a stop. Some tests made on a power braked car, the brakes of which, if required, can be set practically instantaneously, shewed that it consumed on the average some 12 per cent. less energy than a similar vehicle equipped with the hand brakes, the result being explained as due to the above.

Street Car Stops.

A street railway system, to be of the greatest value to the greatest number, and in that way to produce the largest possible earnings, must not only offer to the public a means of relieving them from the manual labor of self-transportation, but must in addition perform that work in a much shorter time than it can otherwise be done. In other words, the question of time continually appears as the deciding factor of ride or not to ride, and to insure the quickest possible schedule, especially in city work, it is most essential that the time occupied by the stops be reduced to the minimum. Almost the only factor affecting the length of stops on an ordinary city car (and herein is a difference between standard long distance steam and electric railroading, where conductors have to make reports, engines have to be inspected, etc.) is the time required to discharge the passengers who desire to leave the car at that point and to take on those awaiting ingress. Any reduction, therefore, which can be made in the time consumed by this operation will be a distinct gain towards an increase in the schedule, and as one means toward that end it would seem that the plan, which has often been suggested in connection with steam railroading, of using one of the car doors for ingress, and the other as an exit, has many points in its favor. On almost every street railway system which operates cars with two entrances there can daily be seen the spectacle of the incoming and outgoing passengers bunched in a jostling crowd, both tempers and clothes get spoiled, and the car waits almost twice as long as is really necessary. Will not some enterprising manager of one of our roads inaugurate the practice? Like all new plans, it will doubtless meet with opposition, but it would appear to possess large possibilities of increasing the average speed of city cars, and once this is plainly demonstrated to the public which uses them, it will without doubt meet with the hearty approval and cooperation of all travellers.

Electrical Equipment for the Rapid Transit Tunnel.

The contract for the motors for the Rapid Transit Tunnel in New York has been awarded after a long series of tests, extending over some time, made under the direction of Mr. L. B. Stillwell, who prepared the specifications under which the sample machines were manufactured. The order, which calls for a total of 680 motors, was divided equally between the General Electric and Westinghouse companies, the former to supply their No. 69 motor, and the latter their No. 86. Both are rated at 200 horse power, their normal input being 300 amperes at 570 volts, and are designed to meet the special requirements obtaining in this particular installation. One of the greatest limitations was, of course, that of space, and as a result the designs submitted are probably of smaller size for their output than any others yet produced, coming as they do within the narrow confines of a standard gauge track and a 33 inch wheel. As is natural in view of the fact that the duties required and the spaces available are practically duplicates, the two designs approach each other quite closely in some directions and are quite widely apart in others. Both use cast steel frames and laminated poles, which are standard practice to-day, the General Electric Company presenting their box frame type, in which the field is cast in one piece, the armature field coils and poles being removed through openings in the end, normally closed by malleable iron heads which carry the armature bearings, those for the axle, which passes outside the frame, being carried in the ordinary manner by axle caps bolted to the frame. The Westinghouse Company design differed radically from the foregoing, they retaining the construction generally adopted for the smaller motors, of casting the main frame in two distinct pieces, recesses being provided in both top and bottom halves for the reception of the corresponding parts of the armature and axle bearings. They also added the somewhat unusual feature of extending the main frame so as to make it completely enclose the car axle. The weight in both cases is about the same, the G. E. Co.'s product being 6000 lbs. and the Westinghouse Co.'s about 10 per cent. heavier. The field coils in both cases are composed of copper strip wound on edge, and provided with liberal insulation, the Westinghouse machine possessing an additional precaution against damage in that the coils are completely sealed in metal cases. Both companies retained the standard railway motor practice of soldering the ends of the armature coils directly into the lugs of the commutator bars, though in the G. E. Company's machine there is a joint at the back end of the armature winding, while the Westinghouse Company made their s of a continuous copper strap.

The General Electric Company were also successful in obtaining the order for the complete controller equipment, which will be of their multiple unit type M form. The main point in which it differs from previous installations of the same character is in the addition of a current limiting device, the grouping into one frame of two or three contactors of the same potential and the arranging of the connections so that each motor is provided with its own set of rheostats, instead of having one set common to all the motors on a car, as has been the case with other installations. The most valuable feature appears to be the current limiting device, which takes from the motorman the power to accelerate at more than a given and determined rate, thus preventing abuse of both the equipments on the cars and incidentally those in the power station. The device is very simple, consisting mainly of a spring connection between the handle and the drum of the master controller, and a relay in series with the main circuit, which, if the current rises beyond the limit desired, locks the cylinder, and prevents it moving further until the car has accelerated and the current fallen. The handle can in the meantime be moved to the ultimate position desired, the cylinder following as fast as permitted by the relay.

The promotors of an electric railway from Toronto to Hamilton, are Messrs. Charles L. Denison, F.A. Drake, J.T. Gilmour, J. B. Gilmour and F. H. Markey.

WIRELESS TELEGRAPHY AND TELEPHONY.

Many persons will be astonished to learn that one of the first wireless telegraph stations on this continent, and certainly the first in Canada, is the Fighting Island station situated near the old historic Canadian fort at Amherstburg, Ont. It was established over a year ago in conjunction with a station at Detroit, and is still in actual operation, being controlled and owned by the Clark Wireless Telegraph-Telephone Company, incorporated by the State of Michigan. This company, at the head of which is Mr. Thomas E. Clark (a Canadian, born in the County of Essex), have their factory, laboratories and testing station at Detroit, Mich.

The international line between Canada and the United States was opened by the Mayor of Detroit, a copy of the message received being attested over the Mayor's signature as below :—

Executive Office,
Detroit, Michigan.

William C. Maybury, Mayor.

"Michigan has given to the scientific world many illustrious names. Among them Watson, the great seer of the skies : In geology, Houghton and Winchell: To the electric world Vanderpool, who first made practical the electric railroad. Here Edison received his first inspirations and now we may hope that a compeer, if not a greater than Marconi, may have arisen in this favored territory.

Correct as received,
William C. Maybury."

The Clark Company are making a special feature of the manufacture and supply of college and educational plants or apparatus. They will also supply complete plants to any companies wishing to go into the business of wireless telegraphy or telephony. They can furnish the smallest plant from an experimental students' set up to one for two hundred miles transmission.

When a representative of this journal called at the Detroit testing station, every facility was afforded him to test the accuracy of the messages received. He saw messages sent and answered, and himself personally received a message at Detroit, via "wireless" from the Fighting Island station. The message as received comes over a ticker or receiver in the Morse code of dots and dashes. In the laboratory he saw wireless alarm bells, a button pressed at one end of the room started an alarm at the other end. The company have several patents already out covering new features in wireless work, one of which will do away with collisions on railways if the engineer is not deaf to an alarm bell. Another interesting thing shown to our representative was a small motor being driven by wireless current. He asked himself the question "when will the possibilities of electricity cease?"

Exterior View Wireless Telegraph Station Located at Fighting Island, Canada, Used as a Testing Station, and Equipped Complete for Telegraphing with Lake Steamers. Mast for Wires, 225 Feet High.

The diligence of Marconi, Clark and other workers all over the world has brought wireless telegraph-telephone apparatus past the experimental stage. Much remains to be done, but much has been done, so that both systems, and especially apparatus, have been put into what will no doubt prove to be a more or less final form and up-to-date.

Interior View of Fighting Island Station, Canada. Equipped with Complete Wireless Telegraph Apparatus.

Mr. Clark, the general manager, himself an electrician of considerable experience, formerly with the General Electric Company at Schenectady, N. Y., has associated himself with some of the best French and German experts, and a large new factory is about to be built at Detroit.

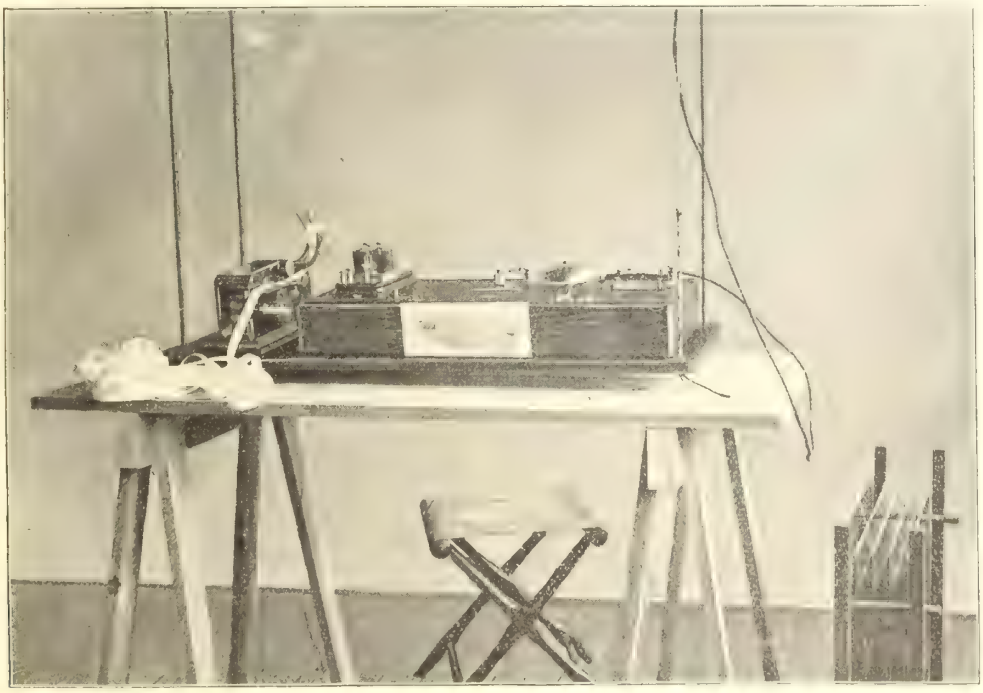
We have much pleasure in giving an interior and exterior view of the Canadian testing station at Fighting Island.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.

The arrangements for the annual convention of the Canadian Electrical Association, to be held in Toronto on the 10th, 11th and 12th of June, are progressing satisfactorily. Arrangements have been made with the management to make the new King Edward Hotel headquarters of the convention. The business sessions will be held there, also the annual banquet.

Among the social features will be a Tally-ho drive to the principal points of interest in the city, by courtesy of the Canadian General Electric Company, also a visit by special cars to the extensive works of the Canada Foundry Company on the outskirts of the city, this by courtesy of the Canada Foundry Company. A number of other social features are under contemplation, so that visitors may rely upon the occasion being a pleasant as well as a profitable one. The Committe on Papers have succeeded in securing the necessary number, the subjects covering the different phases of electrical work, and the authors being recognized authorities on the subjects on which they write.

As the Association has a large membership in Toronto and throughout Western Ontario, it is expected that the attendance will be larger than usual. Every electrical company doing business within two hundred miles of Toronto ought to be represented at this convention, and would find it profitable from a dollar and cents point of view to do so, as subjects of practical interest will be considered and discussed. The complete programme will be published in our June number.



Fighting Island Station, Canada. Interior View, Showing Wireless Telegraph Receiving Instrument Working with Transmitter Station, Detroit.

SUCCESSFUL ELECTRICAL AND ENGINEERING STUDENTS.

The examination results given out last month by the Faculty of Applied Science at McGill University, Montreal, show that the following electrical students were successful :

THIRD YEAR PRIZE MEN.

George H. Cole, Canadian General Electric scholarship; second mathematical prize; prizes for dynamics of machines, calculus and electrical measurements.

Howard K. Dutcher, Canadian General Electric scholarship; third mathematical prize; prizes for theory of structures.

Frederick W. McCloskey, Canadian General Electric scholarship; prizes for mechanics and calculus.

George K. McDougall, Canadian General Electric scholarship.

PASSED THIRD YEAR.

Electrical engineering — George K. McDougall, George H. Cole, and Frederick W. McCloskey, equal; Howard K. Dutcher; John H. Cardew; Louis H. Marrotte, and John Al. Wagner, equal; George W. Scott; John S. H. Wurtele.

PASSED SECOND YEAR.

Electrical engineering Robert W. Boyle, William C. McD. Cropper, Sidney G. F. McDermot, and Charlie Willard, equal; Gavin T. Scouler; William Redpath; Ian McLeish; E. W. Bowness; Staton H. S. Cunha; Hazen A. Wheaton; Delmer C. Findlay; Hiram H. Archibald, and Gordon B. Glassco, equal; John A. Campbell; George A. Johnstone; Kenneth E. Drinkwater; Roy A. Weagant; Oswald A. Mundy; Lockwood Burpee ; Ernest A. Piche; Donald McLean; Clifton H. Wright; Alan Dale Harris; A. Pinto Joseph; E. Courtlandt Eaton; Lawrence L. Price; Walter C. Ross; George L. Dickson.

The Hinton Electric Company, of Vancouver, have installed a large electric light plant for the Brunette Saw Mill Company, of Sapperton, B. C. It will be used for lighting the mill, offices and yards.

HINTS FOR THE DYNAMO TENDER.

By R. Max Eaton.

An attendant for electrical machinery should understand the elementary principles of electricity, the units of measurement and how to apply them, the laws and phenomena of induction, the principle involved in the different styles of dynamos, and have an intelligent knowledge of the electrical science in all its branches.

The following consists of suggestions covering some of the more important features with which a dynamo attendant should be familiar.

Cleanliness I place first on the list, for I believe it is the most important feature in the operation of a central station. What a story the appearance of a dynamo room and the machines tell to a close observer.

It is unnecessary to comment, to any length, on this point, because the fact has been so well established, that the greatest enemy to the successful operation of electrical machinery is dirt. The fact that a generator may be nicely painted and well finished does not increase its efficiency, but it certainly will act as an incentive for the operator to keep it clean and of a good appearance, and that of itself is of considerable importance.

Machines should always be cleaned immediately after they are shut down. Better results can be accomplished then than if allowed to cool, as it is then much more difficult to remove the oil and grit.

The dust and dirt in the inaccessible parts of a machine are most easily and surely removed by means of an air blast. The air blast is now used for this purpose, especially in stations having a number of machines to keep clean. The air is supplied through a flexible rubber hose, a small portable motor being used to operate the air pump.

If convenient a suitable canvas cover should be provided and placed over a machine after it has been cleaned to prevent dust settling on it.

Installation.—The location selected for the placing of a dynamo should be cool and dry and in such a position if possible that the machine will be easily accessible on all sides. Do not place it in such a way that it would be impossible to remove the armature without moving the entire machine. This is a mistake that is often thoughtlessly made. In placing dynamos of considerable size, a foundation of brick or stone should be provided, constructed if possible separate from the walls of the building. In any case a level and firm foundation ought to be provided.

In placing the parts of a machine together and mounting the apparatus the greatest possible care should be taken to thoroughly clean each part and all connections. The shaft and bearings must be thoroughly wiped before putting the armature in place.

Belting.—The kind of belting to be used is to a great extent a matter of opinion. The standard light-weight, double-leather belt is, however, applicable in most cases and as a general rule satisfactory. Use endless belts by all means, as it is not advisable to operate a high-speed machine of any description by laced belts.

In estimating the size of belt required to do a certain amount of work, it may be taken as a guide that a single belt will transmit approximately 1 H. P. for each inch in width when running at a speed of 1,000 feet per minute. If the speed is greater, the power transmitted will be correspondingly increased, and if it be less the power will be correspondingly decreased.

Always operate a leather belt with the smooth surface next the pulleys and the slack (running) side on top if possible.

On new belts an allowance for stretching should be made, in placing the machine, of ¼ of an inch to the foot in its length. In calculating for speed it is advisable to allow 1 per cent. for slipping, as it is certain to occur to this extent when doing work. Endless belts can be made without the use of rivets; use specially prepared cement for splicing and avoid the use of rivets.

Directions for Starting.—Make a careful examination of the entire machine to see if the connections are all right and also to make sure that no tools have been left carelessly lying about. This sort of an examination becomes a second nature to attendants who have been operating machines for some time, and they unconsciously perform this very important proceeding without thinking that they are doing it. Note if the brushes are all set and have the proper tension. It is often customary to bring dynamos to their full speed before lowering the brushes into contact with the commutator. This is not at all necessary, in fact it is much better to place and set all the brushes before starting at all unless there is some danger of the machine being turned backwards, which would injure copper brushes. The main switch connecting a dynamo into the circuit should not be thrown in until the dynamo is "built up," that is, operating at the required voltage indicated by a voltmeter or pilot lamp; however, this does not apply if a dynamo is operating an independent circuit, for then it does no harm to have the circuit on and allow it to build up with the machine. Never throw a heavy load on a generator suddenly if it can possibly be avoided, but gradually build up its load by means of circuit switches, or if operating in multiple with other machines, the shifting of the load should be done gradually.

Directions for Running.—If a machine is new and is being run for the first time, special attention should be paid to it for a while, and for a short time it is advisable to run it at less than full load if at all convenient to do so. Fresh oil should be added to the bearings quite often and the old run off. Be on the alert for excessive heating of the bearings, field coils, or armature, and if any is discovered no time should be lost in finding the cause and applying a remedy.

Special care should be taken in handling generators which are operating at an E. M. F. of 500 volts or over. "Keep one hand in your pocket" is an old saying; however, this is not always convenient to do, but it serves to illustrate the impression we wish to convey.

Do not overload a dynamo, as this is the direct cause of probably as much trouble as any other individual thing.

Keep all iron or steel tools away, as they might be drawn into the machine by the magnetism and be the cause of entirely ruining it. Copper or brass oil cans should be used for the same reason.

Directions for Stopping.—If a generator is operating in parallel with others gradually remove the load until its ammeter indicates little or no current, then open the switch. Under no circumstances allow the speed to be lowered or the magnetism weakened (except enough to regulate the E. M. F.) before disconnecting. If this were done, the machine would probably run as a motor, taking its current from the main circuit, which might cause no end of damage.

If a machine is operating alone on a circuit, gradually decrease the speed and allow it to stop without touching either the brushes or switches. Do not switch out a dynamo at full or partial load except in a case of emergency.

Never lift a brush while a dynamo is generating current, except when there are other brushes on the same side to remain in contact.

As soon as a dynamo is "shut down" clean it thoroughly and raise the brushes, taking care to wipe all the copper dust from the commutator brushes, and brush holders, after which it should be covered, if a cover is provided.

Sparking at Brushes.—The causes resulting in this trouble are very different in different types of machines. Most all-arc dynamos spark considerably while operating, but that is not objectionable, as they are designed to stand it.

A few of the more common causes of this trouble in direct-current multiple machines are brushes not set at the neutral point, current overload, rough commutator, open coil in armature, short-circuited coil, leak from coil to frame, weak or uneven magnetism, bad brushes or unnecessary vibration of the machine.

If the sparking occurs from the brushes not being set at the neutral point it can be readily overcome by shifting the rocker arm either back-wards or forwards until the neutral or non-sparking point is found.

An overload will produce sparking, as probably the capacity of the commutator and brushes may not be sufficient, and in this case there is no remedy except to reduce the load.

It is not a difficult matter to keep a commutator which has no inherent defects in good condition if attended to properly from the start; but if allowed to get rough and full of ridges it takes considerable care and work to bring it right. It is very damaging to a machine to run it with the commutator in bad condition.

An open coil can be detected by a spark that will appear to travel almost around the commutator. The defective coil can sometimes be found by noticing which bar is most damaged by the spark. If there is not time to repair it the dynamo may be operated for a short while without damage by connecting the two bars together between which the open coil exists. An open very seldom occurs in the coil itself but more generally where the wire is connected to the commutator bar. This is easily found and remedied.

A short-circuited coil will heat much more than any of the others and is very liable to burn out entirely. It may be detected by holding a piece of iron between the pole pieces and in such a way that it will be influenced by the magnetism, and if the pull varies suddenly at a point in each revolution it demonstrates that a defective coil exists. Of course this test must be made while the machine is generating current.

A leak from the windings to the frame may be detected by testing with a magneto bell or by the use of a battery and telephone receiver.

Weak or uneven magnetism will cause sparking and also result in the dynamo not generating its full E. M. F. when running at the required speed.

The brushes should sit on the commutator in such a way that the intended contact service shall all be in contact, and also they should have no ragged edges but ought to be kept properly trimmed.

It may be said that excessive heat exists if the armature or field coils get too hot to keep the hand on for a short time.—Electricity.

ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

The eleventh annual report of the General Electric Company for the year ending January 31st, 1903, has been issued. It is shown that the profits of the company for the past year were approximately $10,000,000. An expenditure of approximately $1,600,000 was incurred chiefly in acquiring the patents of the Sprague Electric Company.

The total sales during the year were upwards of $36,000,000. The orders received included: Generators and rotary converters, capacity over 590,000 kilowatts; railway motors, more than 11,000, capacity over 490,000 horse-power; transformers, capacity over 475,000 kilowatts; stationary motors, more than 16,000; arc lamps, more than 80,000.

Water-power enterprises have been equipped with 428,269 horse-power in General Electric generators. There are now also in operation twenty-four plants equipped with 41,820 horse-power in General Electric generators, which plants are operated partly by steam and partly by water power.

Expenditures aggregating about $2,500,000 exclusive of the cost of patterns, small tools, etc., have been made during the year for real estate, extensions to existing buildings and the erection of new ones, and for additional machinery—all required to take care of the increased business.

The following table shows approximately the increase in floor space and in the number of employees during the past five years:

	Factory Floor Space in Square Feet	Factory Employees
1899	1,800,000	8,000
1900	2,000,000	11,000
1901	2,300,000	12,000
1902	2,500,000	15,000
1903	3,000,000	18,000

The report says: "Engineering work of the past year has been largely devoted to the development of established lines of apparatus. The number and variety of useful applications of electrical machinery have kept pace with the increased volume of business. Standard apparatus has been improved in quality and efficiency, and considerable special apparatus has been designed and manufactured to meet novel conditions.

"There has been a large increase in the equipment of industrial establishments with electric motors, the advantages of the electric motor drive being more clearly recognized with the increase in the number of its applications. Business in such applications showed an increase of forty per cent. during the past year. This increased use of the electric motor has been especially notable in the case of cotton mills, steel plants, cement works, oil refineries and machine works.

"By the purchase of the Sprague patents we have come into possession of the only fundamental and detailed patents, outside of those already owned by our company, covering a successful and satisfactory form of multiple unit control. This system, now known as the Sprague General Electric system, is in successful operation on many roads."

It is interesting to note that the size and voltage of generators and transformers used in connection with long-distance transmission have greatly increased. There are in successful operation transformers of over 50,000 volts, and orders have been secured for others to be used at 80,000 volts.

THE TAYLOR-WHITE PROCESS OF TREATING TOOL STEEL.

Of great interest to all manufacturers and users of machinery is the Taylor-White process of treating tools made of self-hardening steel. This process is the invention of Mr. Taylor, of the Bethlehem Steel Company, South Bethlehem, Pa. The owners of the Canadian patents are the Goldie & McCulloch Company, Limited, of Galt, Ont., who advise us that all the tools they use are treated with this process and that the results have been entirely satisfactory in every way.

It seems that the development of this process of treatment grew out of the necessity for increased output in the machine shop of the Bethlehem Steel Company. The capacity of the forge was far in excess of that of the shop, leading to a large accumulation of forgings awaiting their turn. Mr. Taylor turned his attention to the investigation of the tool steels employed, systematic tests being instituted to determine their comparative merits. It was found that by a special treatment all of the air-hardening steels could be more or less improved, but in order to obtain the maximum of uniformity and efficiency a special composition was required. It will therefore be seen that the new element introduced is not so much a new steel but a new treatment of existing steels. The nature of this treatment is not yet disclosed.

The effect of the treatment on the output of the works was remarkable. Whereas prior to the introduction of the new process the capacity of the forge was far in excess of that of the machine shop, the machine shop now leads the forge, and the latter is being pushed to its utmost to keep the former supplied with material.

Another effect is seen in the increased speed of the line shafts. Formerly, these ran at 90 revolutions per minute, but to obtain the full benefit of the new process it has been found necessary to increase this to the unusual figure for a machine shop of 250 per minute. The countershaft speeds are also being rearranged.

From a report of tests made by the Bethlehem Steel Company we reproduce the following: Regarding the nature of the change in the steel which is brought about by the new treatment, it appears to be simply the raising of the temperature at which it begins to lose its temper. With ordinary steel this temperature is about 500 degrees Fahrenheit, whereas with the treated steel it is about 1100 degrees. The latter temperature corresponds to that of dull redness, and in the test run on the piece of machinery steel the tool became, in fact, distinctly red hot. At this temperature of the tool the appearance of the work was distinctly better than that of the usual roughing cut. The surface was not, of course, a finished surface, but it was a clean-cut surface with none of the torn appearance characteristic of the usual roughing cut.

The chips themselves left the tools at a temperature which drew them to beautiful blues and purples, and this coloring of the chips is the practical shop test of the correct speed of the work. Without water the color of the chips, whether the work is completed or in progress, tells the foreman whether or no the work has been done at the proper speed. In the case of the experimental lathe the Evans cone enabled the exact speeds to be obtained in all cases, and, as stated, the chips were all drawn to blue and purple; but in the case of other tools, having only the usual stepped cone pulleys to regulate the speed, it is not always possible to get the exact speed to produce these colors in chips. It is, however, expected in all cases that the chips will show some color. Where water is used the chips will show no color, but it is then only necessary to turn off the water for a moment to bring out the colors and show if the speed is correct.

It is interesting to note that the tools themselves are not especially hard. Comparison of these tools with Mushet tools by the file showed the latter to be distinctly the harder of the two. It should also be said that, unlike Mushet and other self-hardening steels, this steel is adapted to the making of milling cutters and other tools requiring machine work to be done upon them. Tools of this character were shown, and one of them, which is used in considerable numbers, was of a form which would be quite apt to crack in hardening, but it was stated that no difficulty is experienced in this respect, and the steel is believed to be less difficult to handle in this respect than is ordinary steel. The treatment is not a surface treatment, but is known to extend to the center of a 4-inch bar. The tools from it are easily forged—at least as easily as those from common steel, and much more easily than those from Mushet steel. The treatment is, however, applicable to Mushet steel, and improves it, though to a much less degree than it does the special steel.

It is stated that the development of this process has involved the cutting up into chips of over 200 tons of steel forgings, with an expenditure for material and labor of over $100,000.

TORONTO TECHNICAL SCHOOL.

The following students in electricity, physics and mechanics of the Toronto Technical School were successful at the spring examinations:

Steam Engine—Class I.—R. Steen, P. McCarthy. Class II.—H. Sheardown. Class III.—R. W. Blacklock.

Heat—Class I.—F. Jeffrey, O. B. Haug. Class II.—E. A. Fennell, F. W. Veale, W. Mauder, A. M. Osawa. Class III.—H. Belcher.

Hydrostatics—Class I.—F. Jeffrey, O. W. Haug, F. W. Veale, H. Belcher. Class III.—F. Beaumont.

Mechanics—Class I.—W. Duncan, C. E. Rundell, D. Ross, J. Linton. Class II.—H. Belcher, R. Jacques, A. S. Innes, R. W. Blacklock, G. Garton. Class III.—W. Boyd.

ELECTRICITY.

First Year—Class I.—J. A. Small, W. H. Atkin, J. McCulloch, A. Stewart, F. Jeffrey. Class II.—J. Smith, F. Lewis, E. Machell, J. Godwin, D. Ross, H. Belcher, N. Deverall, C. Andrews, A. F. Burke, J. McCarron, F. Davis, J. O'Neil. Class III.—E. Kendall, W. R. Johnson, E. Stanbury, A. Baldwin, E. J. Dinsmore, F. R. Sheath, A. Simpson, H. Ray, N. Graham.

Second Year—Class I.—W. McCulloch, J.A. Small, W. Gale, W. H. Aitken, M. Adams. Class II.—C. Radford, J. O'Neill, R. W. Blacklock. Class III.—W. J. Leggatt, F. R. Davis, F. Slade.

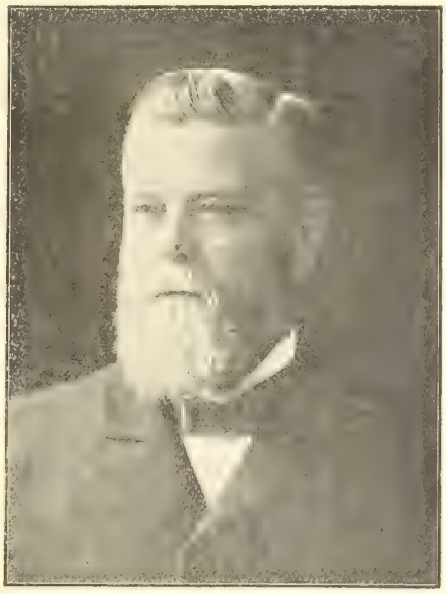
Third Year—Class I.—J. McCulloch. Class II—C. Hand, G. Robinson, H. Satchwill. Class III.—C. Radford.

S. MORGAN SMITH DEAD.

S. Morgan Smith died in Los Angeles, Cal., on April 12th. He had been ill for several months. The direct cause of his death was attributed to heart failure.

The news of his death was a shock to his many business and personal friends. While not a native of York, he resided there for so many years that he became an integral part of that city in its rapid growth. That fact was attested when he first launched into the manufacturing side of that city's interests. Through his individual efforts the success that attended him is shown by the immense plant of the S. Morgan Smith Company, employing about 400 people, whose product is known not only in the United States, but in all foreign countries.

S. Morgan Smith was born February 1st, 1839, in Davis County, North Carolina. He was educated in the public schools of Davis County, North Carolina, and later on attended the Moravian College at Bethlehem, Pa., from which institution he graduated in 1861. During his college course he prepared himself for the ministry and from 1861 to 1866 he was pastor of the Moravian church at York, Pa. In 1864 he was elected chaplain of the Two Hundredth Regiment Pennsylvania Volunteers, in which capacity he served until the end of the war. In 1866 he went to Canal Dover, Ohio, where he had charge of a congregation for five years. Here he was forced to quit the ministerial work on account of a serious throat affliction and he returned to York.



THE LATE S. MORGAN SMITH.

About this time he began giving his attention to the perfecting of a washing machine, known as the "Success," which he invented and had patented. Thousands of these machines were sold. In 1875 he became interested in the manufacture of water wheels. His first wheel was known as the "Success," many of which were installed in mills and factories throughout the country. Later he placed upon the market the "Improved Success," a wheel giving more power than the "Success" of the same diameter. He found ready sale for great numbers of these wheels and many hundreds are in use driving all kinds of machinery. In 1892 he engaged in the manufacture of the "McCormick" water wheel, which has gained a "world wide" reputation. Since he began the manufacture of the last named wheel he has supplied many of the largest plants in operation in the United States and Canada and has shipped extensively to foreign countries. Although the shops were small in which he started the manufacture of water wheels, they have assumed such proportions that at the time of his death they were beyond question the largest and best equipped in the country devoted exclusively to the manufacture of water wheels and power transmitting machinery.

Electrical manufacturing companies have been figuring on a large quantity of machinery and apparatus required by the St. John Street Railway Company, of St. John, N. B. It is estimated that the proposed improvements and extensions to their plant will cost about $300,000. The trackage will be increased from 12 to 18 miles, for which purpose an order for 90-pound rails has been placed with a Glasgow concern.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, May 9th, 1903.

During the longshoremen's strike at the wharves here the linemen refused to erect poles and run wires on wharf properties in sympathy with the longshoremen. Naturally, a good deal of inconvenience was felt through lack of usual arc lights in sheds. It is stated that the local chief (?) of the electrical workmen's union was a former employee of the Montreal Light and Power Company who was discharged for refusing to obey orders.

Complaints are made by some parties using D. C. motors supplied with current formerly by the Standard Company that the new regime, the Montreal Light, Heat & Power Company, will not renew contracts unless for A. C. current. Surely no such arbitrary decision has been promulgated. It would be gross injustice to put merchants to the expense of purchasing new motors if the power company have D. C. lines in the immediate vicinity. D. C. must be supplied to several elevators, and although new customers might be refused D. C., or old customers who move from close proximity to the D. C. lines, there seems no reason why, when the current is there, that old customers cannot renew their D. C. contracts. Besides, those who require variable speed cannot well get along with A. C. This takes no account of price, which will no doubt be increased, but merely to the kind of current supplied.

Mr. F. H. Badger, City Electrician and Superintendent of the Fire Alarm Telegraph of Montreal, was taken ill rather suddenly lately and had to be taken to Portland, Maine, for recuperation. He writes a friend, however, that he is now making rapid strides towards recovery, and hopes to return to Montreal shortly. Meanwhile his duties are filled satisfactorily by Mr. J. A. Ferns, of the fire alarm staff.

The complete back-down and ignominious surrender of the Montreal Street Railway officials during the late strike has, as foretold, brought along an unusual crop of strikes this spring. Carpenters, etc., affected the interior wiring contractors, and now the linemen of the Montreal Light, Heat & Power Company seem desirous of following suit. It is probable, however, that the words of the R. C. Archbishop will have good effect and prevent so much of it, coupled with the fact that the men are beginning to find that they get no public sympathy when led by Yankee agitators.

One point in the last annual report of the Lachine Rapids Hydraulic & Land Company is worthy of comment, viz., where they accuse the Underwriters of laxity in regard to inspections. The contention is only too true, but whose fault is it? Just so long as the Underwriters get this work done for them for nothing they most assuredly will not pay for an inspector. At present the company do inspections, as they claim, for the safety of their own plant in the shape of the meter and transformer, which is undoubtedly right, but do they stop there? Such reports as "D. B. wp'f wire used instead of 'slow burning'"; "cleats incorrectly spaced"; "tape used instead of bushings in sockets"; "moulding not sufficiently 'filled'," are examples, and which, although wrong from Underwriters' point of view, cannot be held to be likely to damage the company's apparatus. This detail inspection caused a certain company at one time to be mulcted about $5,000 in a case where the insurance companies sued for fire damage. The fact of the company assuming such inspection was no doubt a good legal point. The lighting companies' contracts would be the better of a clause stating they assume no responsibility for interior wiring; inspect for their own protection only, and let it go at that. The balance is up to the Underwriters to look out for, and as the loss would be theirs they would pretty soon awake to their duty, as they have done in cities the other side of the line.

The great quesion now among the various, companies' staffs is who is to go and who is to stay. Undoubtedly the consolidation will affect quite a few. There are some weeds which will be well rooted out, and also some who, although they have worked hard and conscientiously, will now be "de trop." It is hard on them.

QUESTIONS AND ANSWERS

"Dynamo Tender": (1). I am desirous of constructing an electro magnet or magnets combined that would be capable of lifting a piece or pieces of wrought or cast iron weighing from one to two lbs. at a distance of from 4 to 5 inches from magnet poles. I have 110 volt and 550 volt alternating current available. Economy of current no consideration. The magnet will remain in service for five hours at a time. The form of magnet pole face best adapted to the purpose would be say 3 inches wide by 8 to 10 inches long. Please give data that may be tried. (2). (a) How should I apply grease to large crown gears eight feet diameter that run continuously at 80 R.P.M.? (b) What kind of grease would you recommend? (c) Could they be run without grease? I wish to avoid as much as possible the grease flying in all directions. (3). (a) Can I use A.C. or D. C. current for ringing 1000 ohm telephones on metallic circuit instead of the hand generation of telephone, with, say, push button and lamp in series. If so, what voltage must be used? (b) What is the strength of the current from a thousand ohm telephone generator? (4). If cabon brushes for D. C. dynamo were soaked in dynamo oil or boiled in parraffin would it improve them? Is the practice recommended?

Ans.—(1). It is impossible to answer your question without further information as to the shape, etc., of the apparatus desired. You would probably obtain the best satisfaction by making up a trial form and using a rheostat in series with your coil. You will obtain the best results from the 110 volt direct current circuit. (2). A mixture of tallow and graphite, applied with a swab or brush, is suitable for the work, as are also various greases which can be obtained from oil manufacturers. It is scarcely practicable to run this class of gearing without lubrication. (3). You can ring your telephone by the alternating generator current, providing the periodicity is not too high. Direct current will not be satisfactory. You can reduce the current to the proper amount by the use of lamps in series, but would probably find a potential transformer to be more satisfactory. The proper voltage will be somewhere about 50 volts, which is approximately the pressure generated by a 1000 ohm instrument. (4). Dynamo oil has scarcely enough body in it to make it suitable for boiling brushes in, but paraffin is much better and its use is frequently recommended.

"Nova Scotian": Can you run a transformer for series arc lighting which is built for two circuits with all the load on one circuit only, or can it be run only up to half load if one circuit is taken away? The Brush Company's arc lighting machine, so I understand, is made so that one, two, three, or four circuits can be run from them. Is this so, and can the whole load be carried on any but the right number of circuits?

Ans.—Two circuit transformers for series alternating circuits, either arc or incandescent, as made by the Canadian General Electric Company, can be run with the load divided in any proportion desired between the two circuits, or all on one and none on the other. Brush arc generators are made for various numbers of circuits up to a maximum of four, depending on the size and style of the particular machine in question. The load can be divided, the same as in the alternating system, in any way desired between any number of circuits up to the maximum for which any given machine is built.

"J. F.," Montreal: Will a 60-cycle fan motor operate on a 125 cycle circuit and vice versa? Can a direct current motor be operated on an alternating circuit?

Ans.—It depends to a great extent on the particular motor you have, but generally speaking they will not. A 125 cycle machine will run on 60 cycles, but only at about half speed and with a somewhat greater current consumption. Re your last question, we presume you still refer to fan motors and would say that we understand that some companies are running d. c. motors on their a. c. circuits, though with what degree of satisfaction we are unable to say. Perhaps some of our readers may be able to give more information on this point.

"Electrician": Can a wattmeter which is built to go directly into a low potential secondary circuit be connected into the primary, with current and potential transformers, and operate satisfactorily? Will it need to be recalibrated?

Ans.—A wattmeter will operate without difficulty under the conditions you describe, provided the voltage of the potential transformer and the current of the series transformer are within its range. It will not need to be recalibrated, but you will have to alter the constant by an amount depending upon the ratio of the two transformers. Thus if the original constant was 2, and the current transformer has a ratio of 600 to 5, or 120, and the potential transformer a ratio of 2200 to 110, or 20, the new constant for the meter will be 120 x 20 x 2=4800.

"X.Y.Z:" What is an inverted rotary converter? If you have to start from the direct current end of an ordinary rotary converter, and your voltage was so low that you could not get up speed sufficient to bring the machine into synchronism with the alternating lines, how would you get started?

Ans.: (1) An inverted rotary is one which instead of being used as they ordinarily are to change alternating into direct current, is operated to change direct into alternating. (2) You could connect the alternating end, after you had reached the highest speed you could, to the bus bars through a reactance. This would pull the rotary into step and yet not let too much current flow. Another method would be to weaken the shunt field as much as you could, by means of the rheostat, which would speed the machine up slightly, and then open the shunt field entirely. This will, of course, make the speed rise very quickly, and care has to be taken to open the direct current switch before it attains a dangerous point. The alternating current end can then be connected at the proper moment, during the time the speed is falling, the phasing lamps or other device showing the proper instant to close the switch.

The Bell Telephone Company are remodelling their system at Chatham, N.B. Among the improvements will be a new switchboard.

LIQUID FUEL FOR POWER PURPOSES.

To the May number of the Engineering Magazine, Mr. Arthur L. Williston contributes a valuable article on the subject of liquid fuel for power purposes. At the outset he outlines the numerous tests that have been made by the Pennsylvania Railroad, the Chicago, Burlington & Quincy Railroad and other corporations to ascertain the utility of burning oil. Recently there have been discovered new oil fields so extensive that there is good reason to believe that there is an assured supply to meet the demands of the future, while the construction of pipe lines which very materially reduce the cost of transportation, and the high price of coal, have combined to give a new argument for the burning of crude oil for power purposes. It is probable that during the past two years there has been greater increase in its use than in all the previous time since mineral oil was first discovered. Already some manufacturing plants in the Eastern States, which formerly have been dependent on the coal fields of Eastern Pennsylvania, have found themselves able to obtain a cheap supply of crude petroleum, or refuse oil, and are burning it under their boilers. Experiments of the United States Navy in this direction have already warranted the Bureau of Steam Engineering in recommending that on at least one-third of the torpedo boats and torpedo-boat destroyers, liquid fuel installation should be effected without delay ; and a Board of Tests of Liquid Fuel for Naval Purposes, authorized by Congress, is at present conducting an elaborate series of tests to determine the best conditions for oil burning on all classes of vessels, including the armored cruisers and battle-ships.

In California oil is rapidly driving coal out of the field for power purposes. The same is true in Texas, and of much of the territory lying between. The general use of oil has affected not only the power and lighting and manufacturing plants in these regions, but also the railroads and marine transportation as well. With the relative economy, at present prices, between the oil and coal varying from one-eighth to one-half or perhaps less, according to the cost of transporiation from the wells to the differeht points where the oil is consumed, this unusual development is not surprising, and the use of liquid fuel for power purposes is still rapidly growing.

One railroad operating in California is now burning oil on more than one hundred and eighty of its locomotives. Another of the great transcontinental systems is already using oil on about five hundred of its locomotives—which is 30 per cent. of the total number operated by the system—and is equipping others as rapidly as possible. In addition to the use on locomotives, it is using oil on its steamers in San Francisco Bay, and on its river steamers, wite very good results.

It seems to have been pretty definitely settled, says Mr. Williston, that better resnlts can be obtained by introducing the oil in the form of a finely divided spray by means of an atomizer ; and so far as the mechanical part of the problem is concerned it may be said that the greatest difficulty was overcome when it was first realized that the success of oil burning depended largely upon the efficiency obtained in atomizing the fuel. With the oil sprayed under the boilers in this way, it has been found that the fires can be forced at will—even to a degree beyond that which is possible with coal under forced draft. The rate of vaporization and the combustion of oil are limited only by the size of the burners and by the velocity with which the air and products of combustion can be forced through the furnace.

Both compressed air and steam have been successfully used as the atomizing agent, and the majority of the burners now on the market are designed with the openings adjustable so that they may be used with either. Most of these are patented devices, and a very large number have been brought out. The activity of the inventors in this direction can be judged from the statement made in the preliminary report of the Liquid Fuel Board, that new patents for liquid-fuel appliances were being issued in the United States at the rate of thirty a week. Nevertheless, there is a great similarity in principle and in action between these different burners. The author then describes and illustrates two or three of the typical burners in use.

ELECTRIC PROJECT FOR QUEBEC.

A project for an extensive electric railway system through the south shore counties and eastern townships of Quebec is now in tangible form. It is understood that two main lines will be commenced this season, one to connect Montreal with St. Johns by way of Longueuil and Chambly and the other between Montreal and Valleyfield, closely following the river bank and taking in St. Lambert, Laprairie, Chateaguay, and Beauharnois. The roads, according to Mr. F. S. S. Johnson, of Stanbridge, Que., are to be built with heavy tracks and in the most modern way, the cars being 10-odd feet in length, supplied with air brakes and motors capable of running at a speed of between 50 and 60 miles in straight stretches. There will also be parlor coaches for private parties.

It is claimed that this will be one of the largest electric railway systems in Canada, and it will form part of vast plans now being mapped out for an electric road to connect New York with Montreal. It is understood that connections will be made with the important trolley roads in eastern New York—the Berkshires—and nearly a dozen systems in Vermont. Among the lines that are expected to serve as feeders for the projected main line, besides the Montreal and Southern Connties Railroad, are the Troy Traction Company, the Bennington Hoosick Railroad, the Hudson Valley line, the Troy and New England Company, and the Berkshire Street Railway Company, with about fifteen other corporations of less importance. The scheme is reported to be backed by capitalists from New York, Boston and Chicago. The proposed main line from New York to the Canadian border would pass through much attractive scenery, the shore of Lake Champlain, which it will follow, being particularly beautiful. The Montreal and Southern Counties Railway route will also have the scenic advantages of the Richelieu and St. Lawrence rivers. It will further enable the farmers all along the south shore to reach the market of Montreal with their products. The company's intention is to make special arrangements for the carrying of all kinds of farm products between midnight and 6 a.m., thereby allowing the farmers to get their stuff into Montreal in good condition for the morning market.

The St. Francis Hydraulic Power Company are about to commence work on their proposed power plant intended to supply light and power to the mining districts of Black Lake and Thetford Mines, Que. The initial development will probably be 2,000 horse power. The company is capitalized at $500,000.

SCHOOL OF SCIENCE EXAMINATIONS.

The following students in the mechanical and electrical engineering course at the School of Practical Science, Toronto, were successful at the spring examinations :

Degree of E. E.—L. B. Chubbuck.

Honors—First year—H. W. Arens, R. H. Armour, B. Aylesworth, G. G. Bell, W. M. Bristol, W. R. Carson, J. B. Charlebois, S. R. A. Clement, H. S. Fierheller, F. W. Harrison, W. G. Hewson, W. C. Jepson, G. Kribs, W. MacKinnon, S. E. McGorman, C. A. McLean, G. R. Munro, W. G. Nicklin, G. W. Paterson, C. E. Sisson, W. E. Turner.

Second year—A. M. Campbell, W. M. Currie, W. S. Gibson, W. W. Gray, C. P. McGibbon, W. H. Munro, A. E. Pickering, M. R. Riddell, R. S. Smart, W. J. Smither.

Third year—H. H. Angus, J. Breslove, A. E. Davison, F. A. Gaby, G. A. Maus, M. L. Miller, D. H. Pinkney, H. M. Shipe, S. B. Wass.

Pass—First year—F. W. Baldwin, T. R. Blaine, E. Chantrell, F. Dowling, H. M. Fletcher, J. M. Gordon, J. A. Howard, J. W. Leighton, W. D. Mackenzie, H. Mace, R. W. Moffatt, L. W. Morden, L. F. Pattee, G. B. Reynolds, W. L. Richardson, H. V. Serson, C. H. Shiriff, A. Simpson, W. F. Stubbs, L. R. Thomson, E. D. Tillson, A. E. Uren, J. Vaughan, J. H. N. Wilkie.

Second year—J. H. Barrett, M. B. Bonnell, T. D. Brown, R. J. Burley, F. W. Burnham, J. W. Calder, S. E. Craig, H. H. Depew, A. Gray, W. K. Greenwood, C. J. Harris, T. D. Henderson, W. S. H. Keefe, O. B. McCuaig, C. D. McKay, G. J. Manson, W. C. Milne, E. A. Moore, G. Pace, W. S. Pardee, J. Paris, W. J. Peaker, G. S. Roxburgh, P. M. Saunder, F. W. Slatter, C. J. Townsend, S. E. Thomson, B. B. Tucker, J. B. Watson, W. F. Wright.

Third year—H. C. Acres, J. A. Beatty, C. J. Fensom, R. E. George, J. G. Jackson, G. K. Johnston, A. G. Lang, W. J. Larkworthy, J. A. MacFarlane, P. H. Mitchell, E. E. Mullins, I. H. Nevitt, J. P. Oliver, J. D. Pace, B. B. Patten, S. L. Trees, H. F. White, J. A. Whelihan.

H. G. Smith passed the third year with aegrotat standing. H. S. Small has passed the third year, but has failed to comply with the regulations respecting practical work.

Mr. A. M. Wickens, for many years chief engineer, electrician and inspector for the Ontario Government, has resigned, to accept the position of inspector for the newly organized Canadian Casualty and Boiler Inspection Company, of Toronto.

HAMILTON ASSOCIATION OF STATIONARY ENGINEERS.

Good Friday eve for sixteen consecutive years has seen the members of the Canadian Association of Stationary Engineers at Hamilton meet for a banquet, and each year's gathering has been an improvement on the previous one. On April 9th about seventy-five members and guests sat down at the nicely laid tables in the dining room of the Commercial Hotel. It was host Henry McQueen's first banquet since he took over the popular hostelry, and he certainly left nothing undone to give his patrons a good time. The supper included the substantial and the dainty in abundance and was served in good style. The chair was occupied by Thomas Elliott, president, and among the guests were : A. M. Wickens, of Toronto, past president of the executive board ; Mayor Morden. Ald. Stewart, ex-Ald. Jas. Donald and James Gill, of the Collegiate Institute staff. The toast list was :

" The King"—National Anthem. "Canada, Our Home"—Chorus, "The Maple Leaf" ; response, Jas. Donald. " Hamilton, the Ambitious City"—Responses by Mayor Morden and Ald. Stewart. " Manufacturers"—Response by Jas. Gill. "The Executive Head"—Response by past president R. C. Pettigrew ; " Kindred Associations"—Response by past president A. M. Wickens. " The Press"—Response by W. Crockett. " The Ladies"—Responses by Robt. McPherson, H. Gottlieb and M. Sweet. " Our Host and Hostess"—Response by H. McQueen. During the evening songs were contributed by James Jardine, W. W. Hislop and J. Burdjane, H. J. Allan playing the accompaniments. Mandolin and piano music was provided by Eugene A. Rysan and Fred A. Fralick, of the Boston School of Music. The piano, a Morris, was kindly loaned by Mr. T. J. Baine. The committee in charge was composed of W. R. Cornish, past president, chairman ; Thos. Elliot, president ; John Donaldson, vice-president ; J. Ironside, secretary ; F. J. Sculthrop, Thos. Chubb, J. Kennedy and R. C. Pettigrew.

Hamilton Branch is progressive. Last November a committee of this society asked the Board of Education to open up a class in mathematics in the evenings so that young men who had to work could better their positions in that branch of work which required the use of problems, figuring horse-power of engines, etc. This class was started with Jas. Gill, B. A., as teacher. It was a great success and every person who attended improved their time. At the regular meetings of the Association work of an educational character was kept up, nearly every member taking part.

PUBLICATIONS.

We have received from the publishers, Messrs. Spon & Chamberlain, 123 Liberty Street, New York, a copy of specifications for Continuous Current Dynamo Design, which has evidently been compiled with much care. The price of single copies is 25 cents.

S. P. Thompson's latest work is entitled "Design of Dynamo." It is published by Messrs. Spon & Chamberlain, 123 Liberty street, New York, and retails at $3.50. The work is purposely confined to continuous current generators, and as it will be used by engineers chiefly in the United States, the Colonies and Great Britain, calculations and data have been expressed in inch measures. It contains upwards of 250 pages, in addition to eight large folding plates to scale, four pages for windings printed in three colors, and two large folding tables of the S. W. B. and B. & S. wire gauges.

Captain Harrison, of Winnipeg, has made a proposition to establish an electric light plant at Calgary, N. W. T.

Mr. J. Buxton, boiler inspector for the North-West Territories, held an examination recently, when the following candidates sought to obtain certificates : S. T. Hubbard, W. A. Clark, A. Allen, W. Meredith, J. J. Nichols, J. Omand, Jos. Hensdoerfer, Thos. Rattray, W. Short, J. R. Benton, G. E. Bevington, Edmonton ; R. F. Buerlin, Wm. Umbach, A. D. McDairmid, Stony Plain; Dan. McDonald, Morinville ; F. Weder, Beaver Hill ; John Baerg, Fort Saskatchewan ; W. Pullskey, Star ; L. Vanacker, St. Albert.

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INGOTS, SHEETS, WIRE, TUBING, CASTINGS.

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SPARKS.

It is reported that Mr. Thomas McConnell, of Lindsay, Ont., will build a summer hotel on Jackson's island, in Sturgeon Lake, and that he may install an electric light plant.

The lighting contract for the city of Fredericton, N.B., expires this year, and the Council to calling for tenders for a new contract. The installation of a municipal plant is favored by some of the councillors.

A by-law will be submitted to the ratepayers of Gravenhurst, Ont., on May 11th to raise $30,000 for the purchase of the plant of the Gravenhurst Electic Light Company and for improvements and extensions thereto.

Mr. A. F. Barber has submitted a proposition to establish an electric light plant in North Vancouver, B.C. He proposes to incorporate a company under the title of the North Vancouver Light & Power Company and to charge the following rates: For each 16 c.p. light per month: Churches, 40 cents; stores, first four 66c, next six 61c, each additional light 50c; dwellings, first three 55c, next three 45c, each additional 35c; hotels, first twelve 75c, next twenty-five 55c, each additional 45c. The plant would be operated by steam at first.

The annual meeting of the shareholders of the Demarara, Electrical Company, which is controlled by Canadian capitalists, was held in Montreal on April 21st. It was shown that the profits from the operation of the company during the twelve months ended December 31st, 1902, after providing for interest on the bonds and all other charges, were $13,414.45, or 2¼ per cent. upon the share capital. During the year a new boiler, engine, alternator and railway generator were added to the equipment of the power station. The installation of this machinery has put the plant in condition to take up all the lighting and power work that may be offered and enables it to be maintained in good working order at considerably reduced cost. The company also substituted alternating enclosed arc lamps for open arc lamps in its street lighting system. The company is capitalized at $850,000 and control the lighting and tram system of the Island of Demarara.

THE WESTINGHOUSE COMPANY IN CANADA.

The Westinghouse Electrical & Manufacturing Company, of Pittsburg, Pa., have definitely decided to establish a factory in Canada for the purpose of manufacturing the electrical apparatus required to supply the Canadian market. It is proposed to form a Canadian Westinghouse Company and to locate the factory at Hamilton, in conjunction with that of the Westinghouse Air Brake Company now located in that city. It is understood that the company will be capitalized at $2,500,000 and that the proposed works will be of an extensive character.

It is understood that Messrs. T. Ahearn and Warren Y. Soper, of Ottawa, who have represented the Westinghouse Company in Canada for a number of years, will be members of the board of directors of the Canadian company.

The Cantin Company, Warwick, Que., have recently placed an order with J. C. Wilson & Company, Glenora, Ont., for a deep bucket 24 inch "Little Giant" water wheel.

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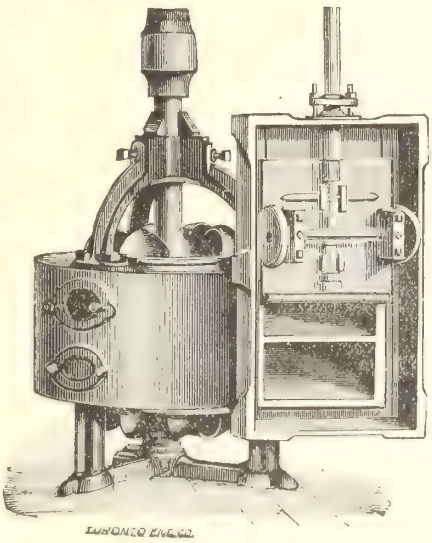

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MOONLIGHT SCHEDULE FOR JUNE.

Date	Light	Date.	Extinguish.	No. of Hours.
June 1	8 00	June 2	3 30	7 30
2	11 15	3	3 30	4 15
3	11 50	4	3 30	3 40
5	0 20	5	3 30	3 10
6	1 00	6	3 30	2 30
7	1 30	7	3 30	2 00
8	No Light	8	No Light	
9	"	9	"	
10	"	10	"	
11	8 00	11	10 00	2 00
12	8 00	12	10 45	2 45
13	8 00	13	11 20	3 20
14	8 10	14	11 50	3 40
15	8 00	16	0 30	4 20
16	8 00	17	1 00	4 50
17	8 00	18	1 30	5 20
18	8 00	19	2 00	5 50
19	8 00	20	2 30	6 20
20	8 00	21	3 10	7 00
21	8 00	22	3 30	7 20
22	8 00	23	3 30	7 20
23	8 00	24	3 30	7 20
24	8 00	25	3 30	7 20
25	8 00	26	3 30	7 20
26	8 00	27	3 30	7 20
27	8 00	28	3 30	7 20
28	8 00	29	3 30	7 20
29	8 00	30	3 30	7 20
30	8 00	July 1	3 30	7 20
		Total............		141 50

The City Council of Guelph, Ont., are negotiating for the purchase of the electric railway of the Guelph Railway Company. The company have asked $100,000 for their plant and franchise.

Messrs. J. N. McKendry, H. L. Dunn, A. D. Crooks and Frank Denton, of Toronto, are seeking incorporation as the Niagara, Queenston and St. Catharines Electric Railway Company, to build an electric railway connecting the places named.

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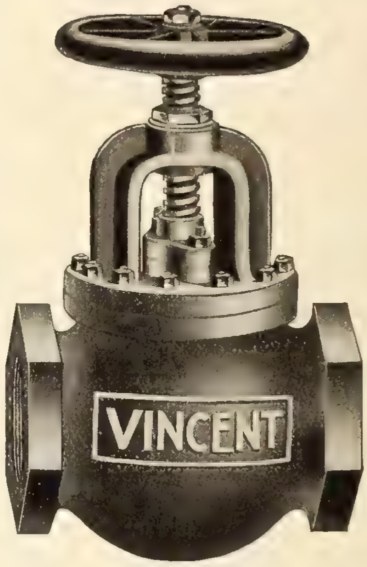
BRONZE DISCS
Outlast All Others
Therefore it Must be
ECONOMY

A COMBINATION OF GOOD POINTS.



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OUR GUARANTEE

The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution.

Any engine failing to meet this guarantee becomes the property of the purchaser upon the payment of one dollar.

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THE WATEROUS ENGINE WORKS CO., Limited, Brantford, Ont.
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SPARKS.

Paris, Ont., is about to build a new electric light station.

The Bell Telephone Company are about to install a telephone system at Emerson, Man.

The Town Council of Windsor Mills, Que., will install a municipal electric light plant. A water power on the Wattcpekah River will be developed.

The Council of Ingersoll, Ont., have offered the Ingersoll Electric Light Company $25,000 for their plant, but the company ask $28,000.

The Winnipeg Street Railway Company have voluntarily increased the wages of their motormen and conductors. The scale now ranges from 17 to 21 cents per hour according to the length of service.

The Stewart Machinery Company, Limited, of Winnipeg, were the successful tenderers for the installation of an electric light plant for the town of Prince Albert, N. W. T., their price being $9,700.

The bill to incorporate the Aluminum Production Company of New Brunswick, Limited, is now before the Provincial Legislature. The capital of the company is $6,000,000. It is proposed to manufacture aluminum and to locate the works in Queens County. Messrs. James Robinson, M.P., James Domville and Charles J. Foster, of St. John, N. B., are the provisional directors.

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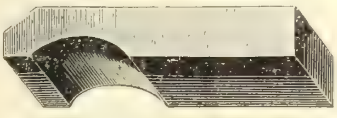
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Owing to reconstruction of plant, a large amount of electrical apparatus will be sold cheap —A. C. Generators, 1,200 volts, 16,000 alternations; 80 to 250 K.W. Exciters; 250 volt D.C. Generators; Switches; Switchboard Voltmeters and Ammeters; Station Transformers; Belting; Iron and Wooden Pulleys, all sizes; Shafting, 3 to 6 inches; Floor Stands and Boxes; Couplings; Frictions and other things too numerous to mention. Mostly in first-class condition.

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SPARKS.

J. C. Wilson & Company, Glenora, Ont., have recently executed for the Northey Company, Toronto, Ont., an order for a pair of heavy iron spur pump gears, finished with machine dressed teeth.

The City of Winnipeg invites proposals up to May 25th for the supply of electric power. The maximum quantity to be used at any time is placed at 1,000 horse power and the minimum at 250 horse power.

The plant of the Northey Company, manufacturers of steam and gasoline engines, pumping machinery, etc., Toronto, has been removed to the new works of the Canada Foundry Company on Davenport Road. The Northey Company is now controlled by the Canadian General Electric Company.

Mr. George Kidd, of Ottawa, has applied for the incorporation of the Canadian Telegraph & Telephone Company. M. Kidd states that the object of the company is to inaugurate and develop a telephone and telegraph system across the Continent, and that the incorporators are American and Canadian capitalists. In addition to telephone and telegraph powers, the incorporators ask for the right to generate and transmit electricity.

The Algoma Electric Company are reported to have taken the contract for wiring a large number of houses at Blind River, Ont., also for the installation of arc lights on the streets.

Judgment was given last month in the long-pending suit of Mr. P. H. Patriarche, of Toronto, against the town of Orillia and Mr. Peter Ryan, arising out of the construction of the Ragged Rapids power plant. The plaintiff's claim involved a total of $112,000. The judge dismissed the claim as presented, but pointed out that should the plaintiff choose to amend his claim and bring it within the terms of the contract found by the court to exist among the parties, he could have $99,275.75. As the town has paid him $46,729.66 he is entitled to receive $42,546.09 with $2,127.30 interest added. Mr. Peter Ryan was allowed his costs. After hearing the judgment Mr. Patriarche announced his intention to appeal.

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Miners and exporters of Electrical Mica, and sole agents for **Jackson Hand Power Rock Drill and Box Electric Rock Drill** for Canada.
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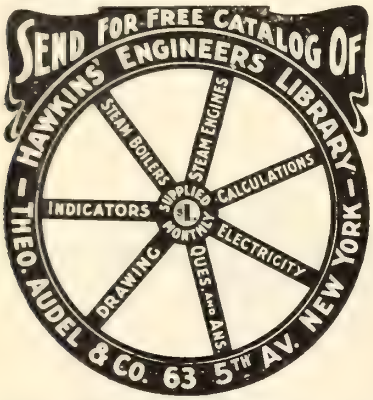

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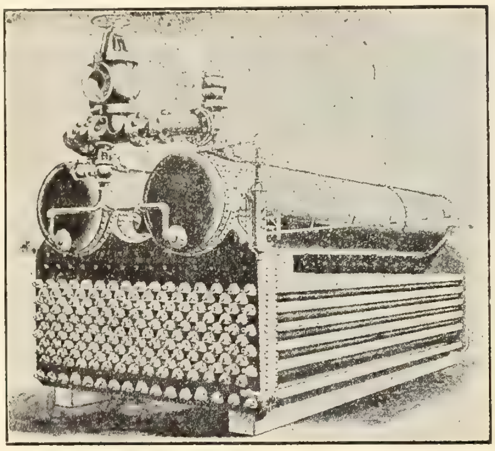

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TRADE NOTES.

The capital stock of the Canadian Rand Drill Company, Sherbrooke, Que., has been increased to $150,000.

The Robb Engineering Company, of Amherst, N. S., are building two 600 h.p. vertical engines of marine type for the Nova Scotia Steel Company, to be used for electric lighting at Sydney Mines.

Messrs. John Starr, Son & Company, of Halifax, N. S., have issued a neat catalogue describing and illustrating their telephones and telephone supplies. Persons interested should ask for Catalogue No. 6.

John Starr, Son & Company, Limited, Halifax, have recently sold to the Nova Scotia Steel & Coal Company, New Glasgow, nine 20 h.p. and two 50 h.p. Westinghouse D. C. motors for use in their rolling mills.

Some British Columbia capitalists are said to be formulating a plan to build a flat rail tramway from North Vancouver to the top of Grouse Mountain. The scheme includes the damming of Lynn creek and establishment of a power plant to run the cars and light the town.

John Starr, Son & Company, Limited, Halifax, N. S., have recently published a very neat illustrated catalogue of their telephones and supplies, containing useful information for installation and maintenance of telephones. We would advise anyone in need of telephones to get a copy of this catalogue, which will be mailed to any address on application.

Increased business and the organization of new departments in connection with the general engineering practice of Messrs. T. Pringle & Sons have necessitated their removal to larger and more convenient offices in the Coristine Building, St. Nicholas street, Montreal. Messrs. F. H. Leonard, jr., and H. G. Turner are in chareg eiielectric generation, transmission and electric motor power department.

The attention of our readers is called to the advertisement in this number of the Chase-Shawmut Company, of Boston, Mass. This company are manufacturers of electrical specialties, such as fuse wire and links, enclosed indicating fuses, junction and outlet boxes, switches, switch-boards, etc. They will be pleased to forward catalogues and give all information regarding their goods to any of our readers who may write them, mentioning the Electrical News.

The Sherwin Williams Company, a large paint manufacturing concern operating several factories in the United States and Canada, have purchased a Westinghouse steam turbine power outfit for their Cleveland factory. The power unit to be installed consists of a Westinghouse steam turbine direct connected to a 400 h.p. two-phase turbo-generator. The current will be generated at 400 volts and 60 cycles will be used for general power and lighting purposes throughout the factory.

J. C. Wilson & Company, Glenora, Ont., make a specialty of machine cut gear wheels. With special machines for dressing the teeth, whether wood or iron, all gears turned out by them are mathematically true, and are therefore light and smooth running. Among recent customers are the Canadian Colored Cotton Mills Company ; the Rathbun Company, Deseronto, Ont. ; Canadian Portland Cement Company, Deseronto ; J. H. Mullin, Bear River, N. S. ; Lakefield Portland Cement Company, Lakefield, Ont. ; S. Waldock, Glenville, Ont. ; Frank Saunders, Gander Bay, N'f'ld. ; and C. C. Brown, Danville, Que.

The Chicago Fuse Wire & M'f'g. Company have just issued their catalogue No. 14, a copy of which is now before us. This catalogue advertises fuse wire, fuse strip and fuse links for electric lighting and power circuits, also fuse blocks and fuses for telephones and telegraph work, together with wire joints and sundry items, all of the company's manufacture. The list is neatly printed on green tinted paper with a gilt cover and is a convenient size for an ordinary pigeon hole. The Chicago Fuse Wire & Mfg. Company believe that their customers will find this list most comprehensive and convenient from which to order. It also gives considerable condensed information. The company now carry stock at their three offices in Chicago, Buffalo and New York. A copy of the catalogue will be sent on request.

The Nova Scotia Telephone Company are building a new two-storey brick exchange at Truro, N. S. The ground floor will be occupied by the company and the upper flat rented as offices. The equipment will consist of a new and modern switchboard, with accommodation for 600 instruments. The general manager of this company is Mr. J. H. Winfield.

Although no definite announcement has been made, it is understood that considerable progress has been made in the direction of bringing together the three electrical companies in Quebec, namely, the Quebec Railway, Light & Power Company, the Quebec Jacques Cartier Electric Company and the Canadian Electric Light Company. It is believed that the control of these companies will eventually pass into the hands of the Montreal Light, Heat & Power Company.

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SPARKS.

The ratepayers of St. Marys Ont., recently voted in favor of expending $1,000 in improving the electric light and waterworks plants.

A power house is being built in connection with the Algonquin Hotel at St Andrews, N. B. It will contain the gasoline and electric plants.

A by-law to grant $60,000 as a bonus to the Berlin, Preston and Galt Electric Railway was defeated by the ratepayers of Berlin, Ont., last month.

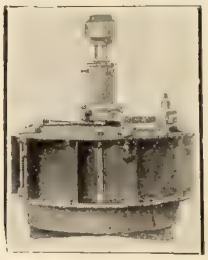
At the Louisiana Purchase Exposition, St. Louis, automatically registering turnstiles connected electrically with dials in a central office will record the admission.

The Bell Telephone Company have undertaken the operation of the telephone system constructed by Mr. Gillies on the Bruce Peninsula, Western Ontario. The construction and the installation of new instruments have been undertaken.

Mr. W. T. Jennings, C.E., of Toronto, with a staff of engineers, has been making surveys for the transmission line of the Toronto-Niagara Power Company from Niagara Falls to Toronto.

The Hamilton & Caledonia Electric Railway Company have applied to the City Council of Hamilton, Ont., for right-of-way in that city. For a portion of the route it is intended to use the existing street railway tracks.

The Stratford Gas & Electric Light Company propose making extensive improvements to their electric plant provided they are given a renewal contract by the city for street lighting. New engines and dynamos will be installed and enclosed arc lamps adopted.



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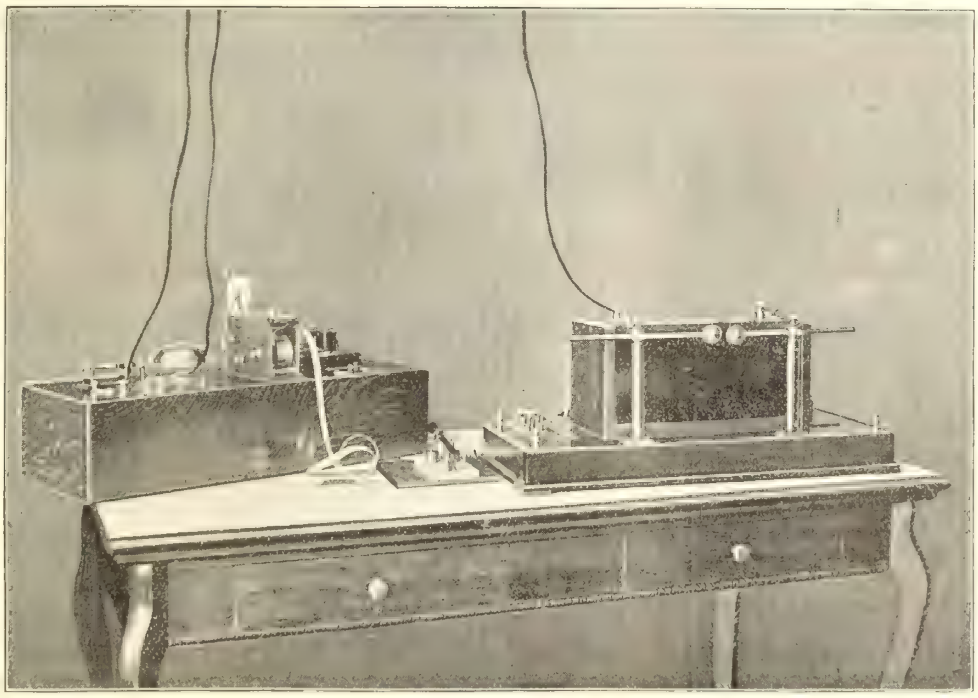

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SPARKS.

Mareate, Ont., will raise $5,000 for improvements to the electric light plant.

The Council of Wiarton, Ont., have appointed a committtee to negotiate for the purchase of the electric light plant.

Several citizens of Clarksburg, Ont., have taken steps to secure the installation of an electric light plant, and are meeting with success.

Messrs. Ross & Holgate, electrical engineers, of Montreal, have made a report on the valuation of the plant of the Sherbrooke Light and Power Company. The valuation fixed is $85,010, whereas the first cost was, according to the company, $80,[illegible]

The question of electric lighting is a live question in Peterboro, Ont., at the present time. Mr. E. J. Philip, of Toronto, has been engaged to recommend the system which would be the best for the town. He will be requested to report as to the best means of abating the pole nuisance.

The New Westminster and Burrard Inlet Telephone Company have purchased a new switch-board for the Victoria office from the Northern Electrical Company, of Montreal. It is of the "central energy" type and will accommodate 1,500 subscribers, and is capable of extension to a maximum capacity of 5,000 subscribers.

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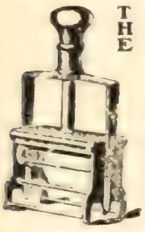

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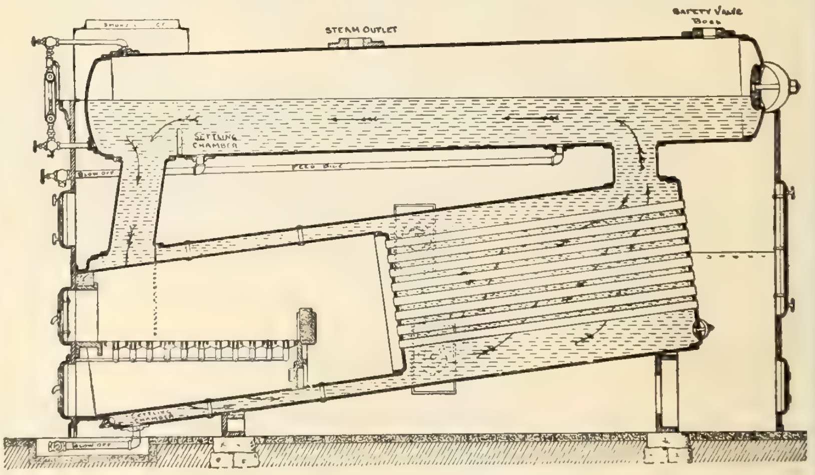

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SPARKS.

The Corporation of Midland, Ont., will install a 2,000 light alternating current generator, on which tenders were recently taken.

Fogarty Bros., of Montreal, have secured the contract for the electric lighting equipment for the Locomotive & Machine Company's new building at Longue Point.

The installation of the electric light plant for the town of Edmonton, N. W. T., is almost completed. The plant was supplied by the Canadian General Electric Company.

The Council of Coaticook, Que., have offered the Coaticook Electric Light Company $30,000 for their plant. If this price is not accepted it is probable that a municipal plant may be installed.

The Stratford Mill Builbing Company have just placed an order with J. C. Wilson & Company, Glenora, Ont., for a 21-inch virtical "Little Giant" for driving a mill they are fitting up for a customer.

The project for building an electric railway on the south shore of the St. Lawrence river, in the Province of Quebec, has been revived. Mr. A. J. Corriveau states that it will take a tangible form this summer, when construction work will be commenced upon two of the main lines.

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SPARKS.

The electric light plant at Palmerston, Ont., has been purchased by the corporation.

The Dominion Government has appropriated funds for the construction of a telegraph line from Ashcroft to Vancouver, B. C.

Mr. W. W. Gordon has entered into a new contract for lighting the streets of Glencoe, Ont., by his electric plant, the price to be $168 per year.

The contract recently secured by the Canadian General Electric Company from the council of Fort William, Ont., includes one 50-light transformer and 50 series alternating current enclosed arc lamps complete with switch-board and accessories.

The Street Railway Men's Union of Montreal have adopted a by-law providing for the establishment of schools of instruction whereby motormen and conductors may become skilled in their calling and render a better service to the company and the public.

J. C. Wilson & Company, Glenora, Ont., makers of the "Little Giant" water wheel, in both vertical and horizontal mountings, write us saying that never before so early in the year had they so many orders booked ahead as at the present time. The demand is not confined to the home trade alone, as they have already this year sold through their English representative nineteen vertical and two horizontal Little Giants for use abroad.

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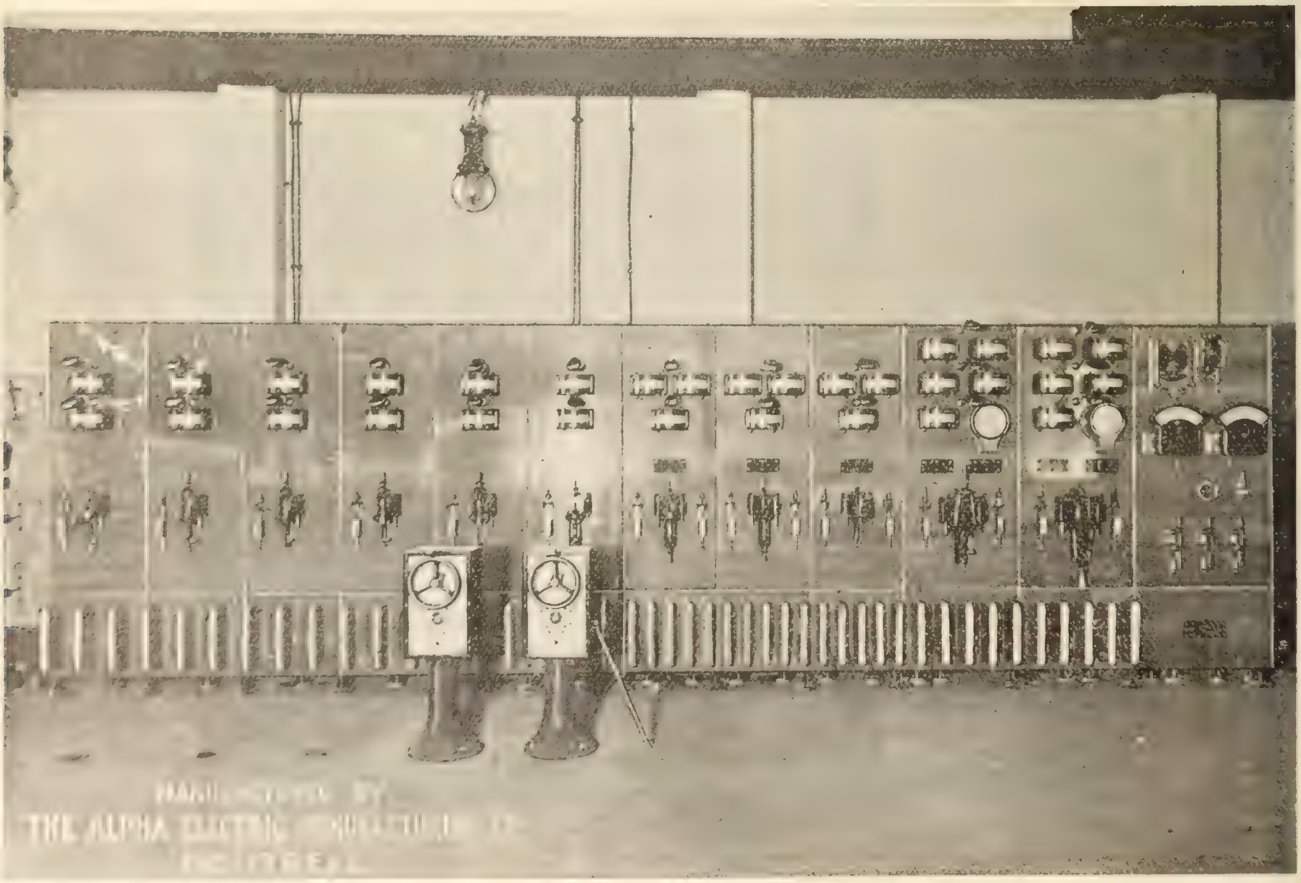

Back view of this Switch-board can be seen in the Canadian Engineer or in last issue of Electrical News.

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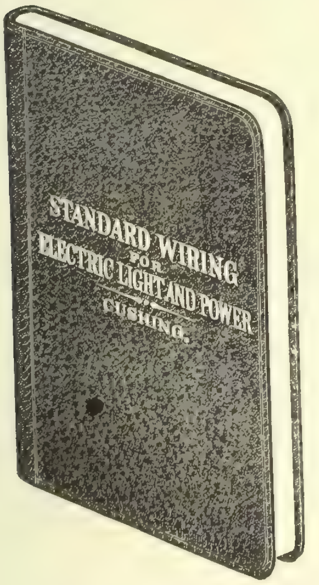

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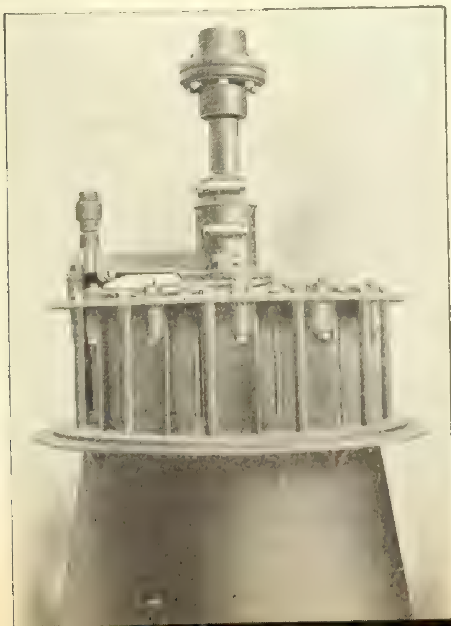

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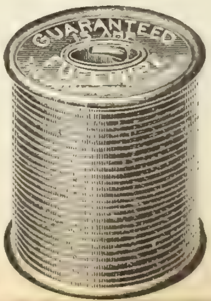

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CANADIAN

Electrical News

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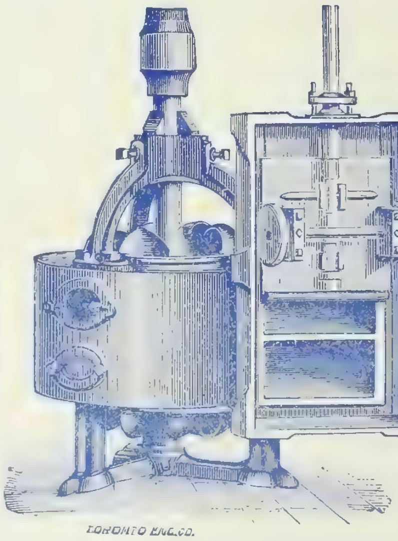

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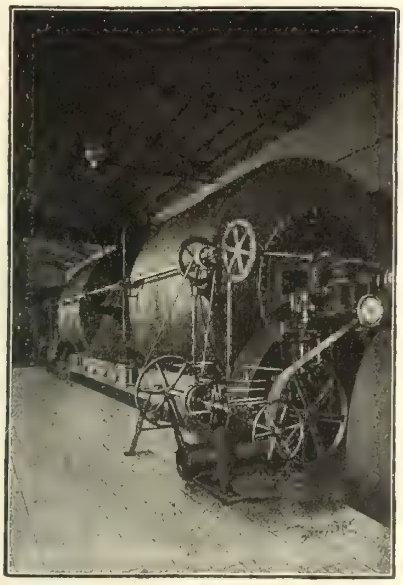

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PERSONAL.

Mr. J. J. Hackney has been appointed manager of the Guelph Street Railway.

Mr. Chas. Branders has opened an office as consulting engineer in the Liverpool, London and Globe Insurance Building, Montreal. His professional card appears in this number.

Mr. George Taylor, late of the Canadian General Electric Company, Montreal, has been appointed assistant superintendent of the Sherbrooke Light, Heat and Power Company, Sherbrooke, Que., as successor to Mr. A. G. Sangster.

It is understood that Mr. Thomas Burns, assistant engineer at the Parliament Buildings, Toronto, will be promoted to the position of chief engineer made vacant by the resignation of Mr. A. M. Wickens. Mr. Burns has occupied his present position ever since the new buildings were erected.

Mr. R. S. Kelsch, who was for several years chief electrician for the Lachine Rapids Hydraulic & Land Company, of Montreal, has resigned his position, and opened an office in Montreal as consulting electrical engineer. The attention of our readers is directed to his professional card appearing in this paper.

A committee, representing the employees of the different departments of the Bell Telephone Company in Toronto, waited on Mr. A. M. Stark, the late superintendent of the company, on May 20th, and presented him, on behalf of all the employees of the company in Toronto with a handsome cabinet of sterling silver tableware and an illuminated address, expressing their appreciation of the courteous treatment they had always received from him. Mr. Stark replied briefly but feelingly to the address, after which refreshments were served, and an enjoyable social evening spent in music, etc.

SPARKS.

The Inland Light & Power Company, Limited, capital $50,000, has been incorporated by the British Columbia Government.

Work is about to be commenced on a new boiler house at the electric light station owned by the Corporation of Fort William, Ont.

The E. S. Harrison Company, of Winnipeg, are installing an electric plant for the Killarney Electric Light & Power Company, of Killarney, Man.

An engineer has been appointed to value the plant of the Perth Electric Light Company, of Perth, Ont., which may be taken over by the town.

The town of Listowel, Ont., has been granted permission by the Ontario Legislature to purchase the plant of the Listowel Electric Light Company.

Mr. R. E. Speakman, C. E., of Toronto, has been engaged to prepare plans for the installation of an electric plant for the corporation of Whitby, Ont.

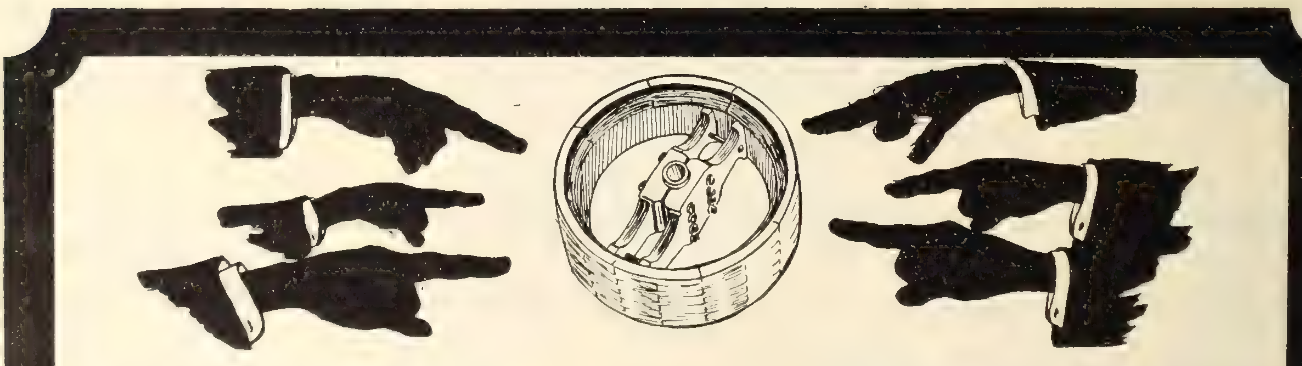
The village of Niagara Falls, Ont., is about to replace the five arc lamps on the streets with fifty 32 candle power incandescent lamps, at an estimated cost of $600.

The Montreal Street Railway Company have extended their Atwater avenue northward a distance of one-half mile. They have also put down a large quantity of ninety-six pound rails.

The Martin Electric Supply Company, of St. Catharines, Ont., have received an order to install 250 lights, complete with generator, switch-board, and wiring, in the Montrose Paper Mill, Thorold, Ont., also a contract from The Warren Electric Company to install 100 lights, telephones, call bells, etc., in their factory in St. Catharines, which will soon be ready for operation.

The Huron, Bruce & Grey Electric Railway Company have been granted an extension to their charter permitting the operation and construction of a line from Dungannon to Walkerton and Wingham, and from a point on the boundary between Huron and Middlesex to Sarnia. Direct communication with the city of London will be secured by means of the London, Parkhill & Grand Bend Electric Railway.

The Martin Electric Supply Company, of St. Catharines, Ont., have received a contract for installing a complete electric plant, for 100 incandescent lights, for the Delhi Canning Company, Delhi, Ont. They have also taken orders for installing and supplying one 15 h. p., a. c. two-phase, ampere motor for the Ellis Mfg. Co., of Hamilton, and one 5 h. p., three-phase motor, for Ecclestone's Steam Laundry, St. Catharines.



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SIXTH: The open spaces usually found in most wood pulleys around the head of the arms, are filled with a plastic material which hardens without shrinking and gives a perfect support to the arms.

Dodge Wood Split Pulleys weigh two-thirds less than iron pulleys, transmit far more power, cost less, last longer and are more adaptable. Better write for prices to-day.

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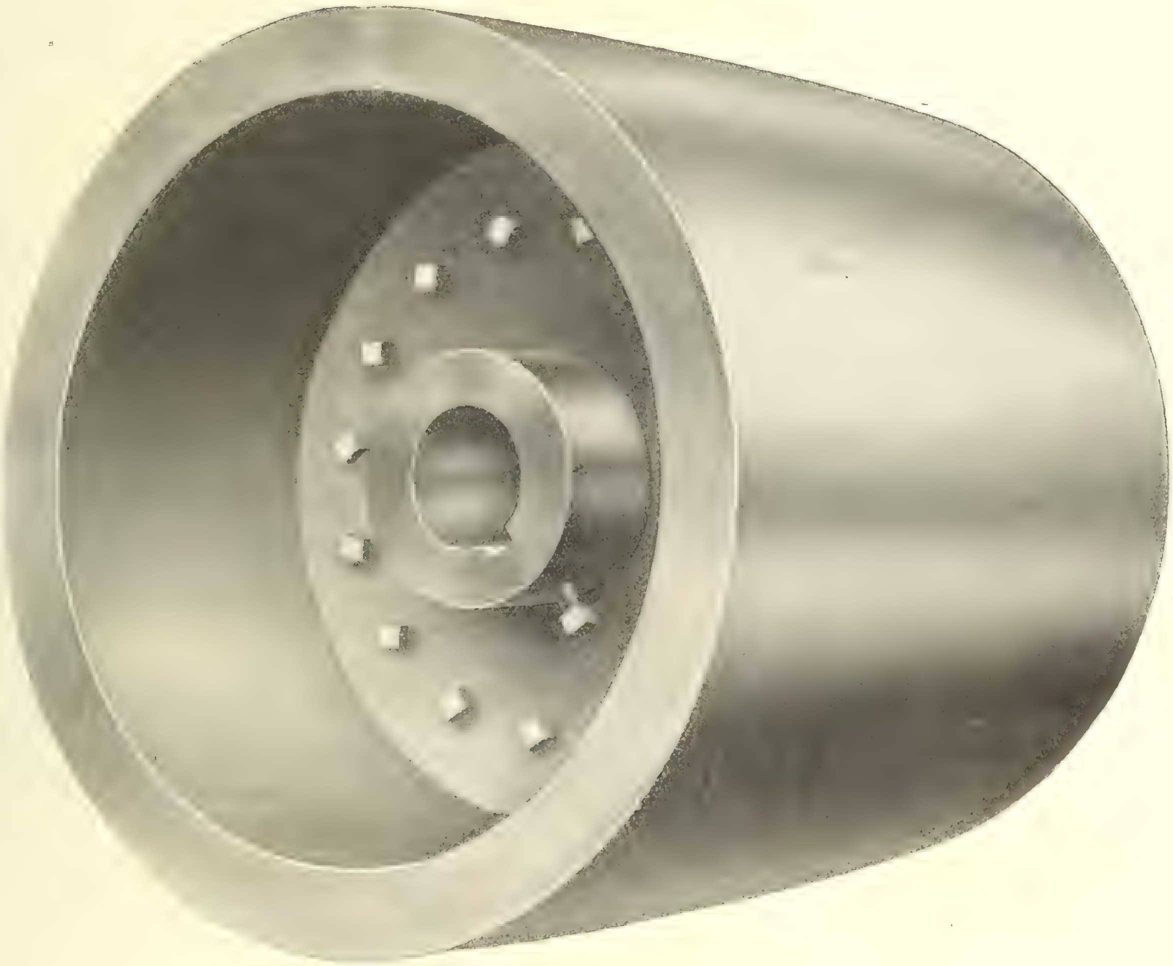

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WE MAKE ALL SIZES. NONE TOO LARGE OR NONE TOO SMALL.

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CINCINNATI, OHIO

USING DISTILLED WATER.

Steam users are better educated at the present time concerning the value of exhaust steam than they were ten years ago, says W. H. Wakeman in the Tradesman, but they still throw away much distilled water that should be used instead of taking fresh water that is full of scale-making impurities.

If we suould go to some of these men who own small shops and mills, where they are using boilers that are badly coated with scale, and advise them to use distilled water, they would consider it a very expensive scheme, because they would think it meant the installation of special apparatus for distilling it, yet these men are heating their shops and mills with exhaust steam, and as the resulting water flows out of the drip pipes it is allowed to run into a convenient brook, and other water is used to feed the boilers.

Does it ever occur to them that this is distilled water? If this is understood, why is it allowed to waste month after month? It is possible that some neighbor has had trouble with his boilers on account of grease accumulating in them, and on this account has abandoned the plan of using distilled water, therefore others hesitate about adopting it.

Grease should never be allowed to enter boilers, as it is both dangerous and unprofitable, but because condensed exhaust steam, or distilled water is used to feed them, it does not necessarily follow that grease must enter with it. Put a separator on the exhaust pipe, and take the cylinder oil out, and there will be no grease left to go into the boilers.

Sometimes only a thick, heavy grease is found in boilers where no separator is in use, although a very fine appearing cylinder oil is used in the engine, but this is due to the fact that many cylinder oils are compounded by mixing several ingredients together.

The light parts disappear. We might say that they are decomposed, and use other big words in this connection, but it answers every purpose to state that they disappear. The heavy parts remain behind and as they pass into the boiler and are carried about by the swiftly moving currents of water, they come in contact with particles of dirt and sediment, and the whole thus forms a heavy mass, about the consistency of paste, that finally settles on the fire sheets and prevents water from reaching them.

It is unnecessary to enlarge upon the evils resulting from such a condition of affairs, as they are well known, but it will do no harm to emphasize the fact that oil should be kept out of all boilers. We have been told that oil is good for them, as it prevents the formation of scale, but to this we reply that if anybody wants to put oil into boilers for any purpose whatever, we have no objection, but do not arrange matters so that oil must go into the boilers, whether the engineer wants it or not, as it it is poor and often dangerous practice.

If a given separator does not remove all oil from the exhaust steam, try a different kind of oil, as all kinds are not alike in this respect. When a kind is found that answers the purpose, do not change to another brand, because you can get it a few cents cheaper, as there is much chance for it to prove a very costly experiment.

There are always some steam users who wish to install a home-made affair to answer a given purpose. Even if it costs more than an apparatus that is sold in the open market at a reasonable price, on which money has been spent in efforts to perfect it, they still want the home-made article.

Direct Connected Generators
For Railway, Lighting and Power

Belt Driven Generators

Multi Voltage System
For Variable Speed Control.

Crane Motors and Controllers

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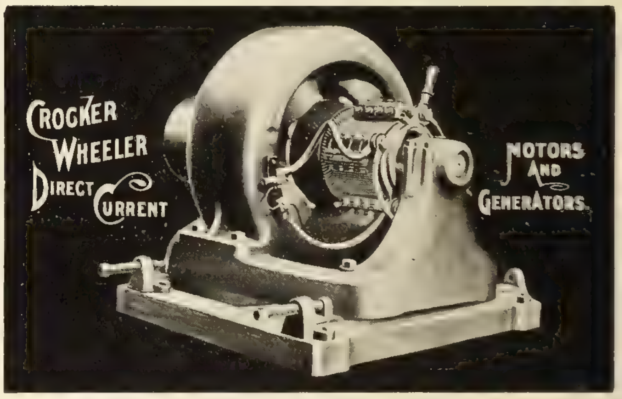

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Transformers.

An unnecessary expense is a luxury. Transformer troubles and expense are pretty much the same thing, and what is more are a luxury that you can well afford to do without. Use Pittsburgh transformers and save a lot of trouble.

The R. E. T. Pringle Company, Limited, Sales Agents

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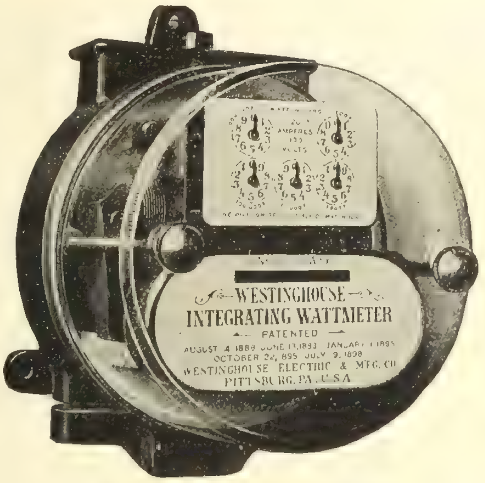

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No matter how perfect your installation may be, your are not deriving the best service or the most economical results unless you are using Packard Lamps.

For the reason—Packard Lamps have long life, they are closely rated and of a very high efficiency.

The ratio of first cost and economical usage, as found in Packard Lamps, marks them the lowest priced in attaining the best results that go to make the highest type of superior lamp service.

Of course you have heard of the Hylo—the "turn down" lamp. We are exclusive manufacturers of this convenient, economical lamp. For use in the home —for storerooms, closets, vaults and a hundred and one places the lamp is most desirable.

By addressing us at the factory, St. Catharines, or at our eastern offices, Montreal, we shall be pleased to send you literature concerning our lamp production.

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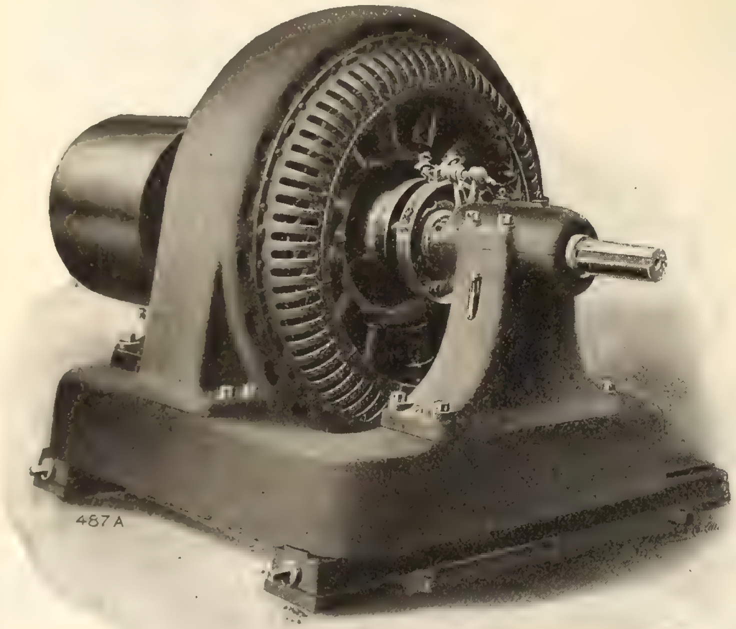

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Direct Current Motors and Generators built in capacities up to 1,000 K. W.

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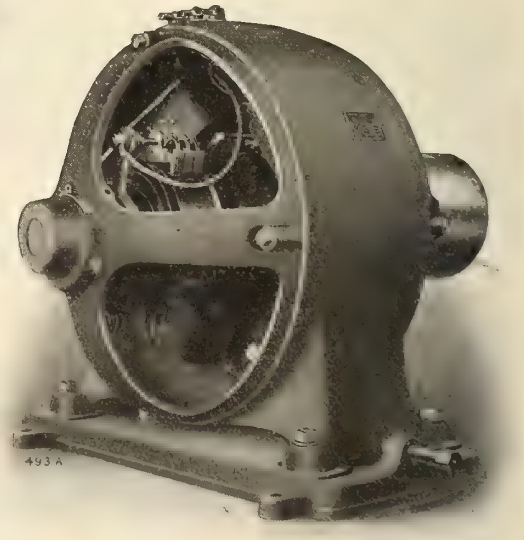

30 H.P. MOTOR.

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OF CANADA, LIMITED.

Visiting Engineers are invited to call and examine the exhibit of the

CHAPMAN DOUBLE BALL BEARINGS

At the Company's Office, 39 Scott Street (at the rear
of the King Edward Hotel.)

The exhibit consists of a cylinder weighing 5,000 lbs. running on the Chapman Double Ball Bearings. It has been run continuously for over two years four months, ten hours per day for seven months, and eight hours per day for the remainder of the time, at a speed of 525 revolutions per minute; no lubrication whatever being used, and there is no perceptible wear on any part of the bearing.

The bearing is also shown as adapted to racing sulkies, carriages, waggons and heavy truck hubs and wheels. The Chapman Compound Bearing, which consists of the ordinary straight journal bearing inside the Double Ball Bearing, is shown as applied to railroad car trucks and motors, mill shafting and electric motors, in all of which the operative conditions require allowance for lateral movement or side play. These bearings have been thoroughly tested under the most trying conditions and have given complete satisfaction. They have been run on steam turbines (Parsons) at a speed of 4200 revolutions per minute, motors at a speed of 1800 revolutions and emery grinders at a speed of 16000 revolutions per minute without lubrication and showing no signs of heat or wear.

GARDNER, WESTMINSTER AND FITCHBURG STREET RAILWAY CO.

C. A. JEFTS, Superintendent, Superintendent's Office, Gardner, Mass, March 2, 1903.

The Chapman Double Ball Bearing Co.

GENTLEMEN:—In reply to your inquiry in relation to the Electric Car equipped with the Chapman Double Ball Bearing, I will say we have had the car in practical use and I have no hesitation in saying the car runs ver easily, not in my judgment taking one-half the power required to run our single truck cars. No oil is needed; practically no care; it is always ready to run; will take the curves in fine shape; will run through the snow that will block other cars.

I believe this bearing must come into general use on cars.

Yours truly, C. A. JEFTS, Superintendent.

This car by actual tests has shown a saving of 60% of power over cars equipped with the straight journal bearings.

ORSWELL MILLS.
High-Grade Cotton Yarns,
FITCHBURG, MASS.

W. J. MURRAY, Esq. Toronto, Ont. February 13th, 1903.

DEAR SIR,—Your favor of the 11th is received, and in reply would say that we have a line of shafting about 300 feet long, equipped with the Chapman Double Ball Bearings. It has been running about two years, at 600 revolutions per minute, and it has worked to our utmost satisfaction. It has given us no trouble, there is no preceptible sign of wear, and it has been run without oil. This line with ordinary journal bearings, was tested for about a week when we made the change, and the test made with the Emerson power scales showed a saving, with the ball bearings, of over 20%. Our experience has been so satisfactory that we have placed an order for another line of about equal length, which will make one of our rooms entirely equipped with these ball bearings.

Trusting the above answers your questions in full, we remain,

Yours truly,
ORSWELL MILLS.
W. F. Stiles, Treas.

The load upon this shafting is about 125 H. P.

PEPPERELL CARD AND PAPER CO.,
East Pepperell, Mass.

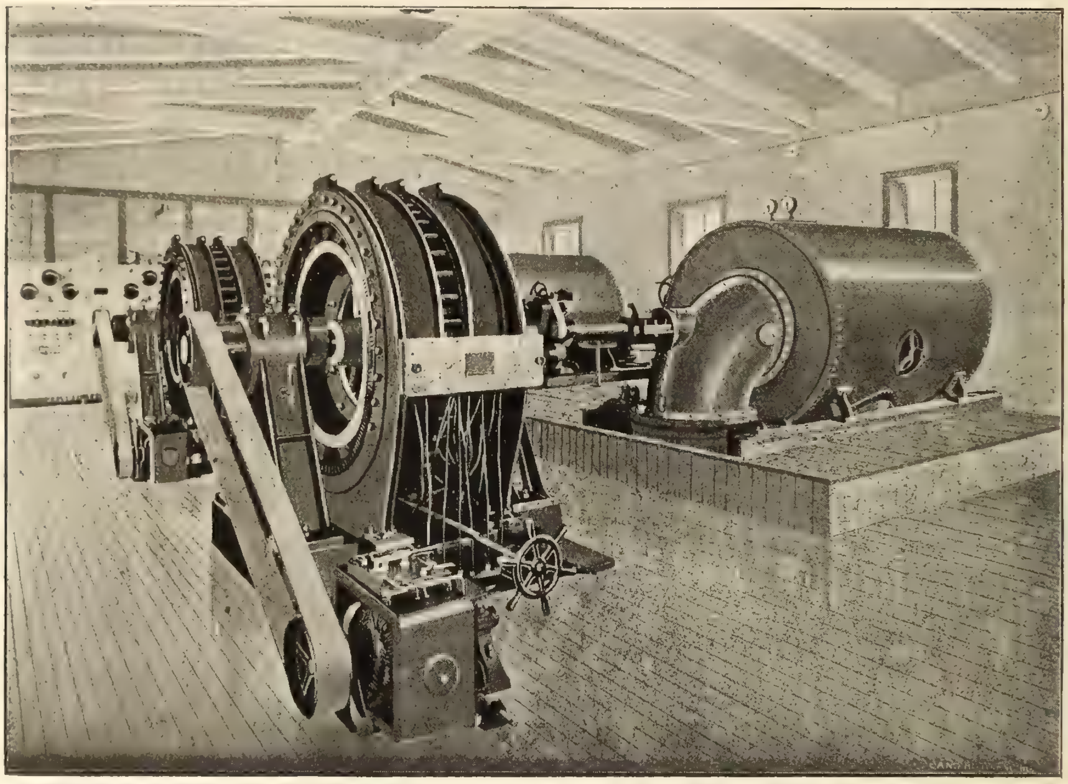
W. J. MURRAY, Esq., Toronto, Ont. Feb. 17, 1903.

DEAR SIR,—On my return I have yours of the 11th in relation to the Chapman Double Ball Bearing. Would say we have one in use, and it has been running a year and a half, and has not been taken apart or in any way meddled with, and we have no reason to doubt but what it is in as good shape as it was when it was installed. On account of its working to our satisfaction, I have given Mr. Chapman an order to equip my main line of shafting, 300′ long, with the Chapman Double Ball Bearings.

The bearing is situated on the end of a 4″ shafting with a pulley next to the box, with a 16″ belt on the same, using from 50 to 60 h.p.

Yours truly, PEPPERELL CARD & PAPER CO.

THE CROCKER PATENT TURBINE



THE NORTH SHORE POWER COMPANY.

This shows the power station of the North Shore Power Company at St. Narcisse, Que.

Two pairs of Crocker Turbines, 20″ in diameter, are direct connected, as shown, to electric generators, and, running under a head of fifty feet, supply the city of Three Rivers, seventeen miles distant, with power and light.

This installation has met with the approval of all parties interested, and we take pleasure in referring those in need of power installation to this company, the North Shore Power Company, Three Rivers, Que.

Other installations of Crocker Turbines are shown from time to time in this magazine, and our 90 page catalog will be found full of interesting details respecting them, as well as data useful to those employing water power in any way.

We will gladly mail this catalog (No. 200) to anyone inquiring, and will be glad also to furnish any additional information which may be desired about prospective installations.

Our several branches enable us to have representatives call on inquirers, when desired, with the least possible amount of delay.

The Jenckes Machine Company

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Toronto
Winnipeg

634 Lansdowne Street
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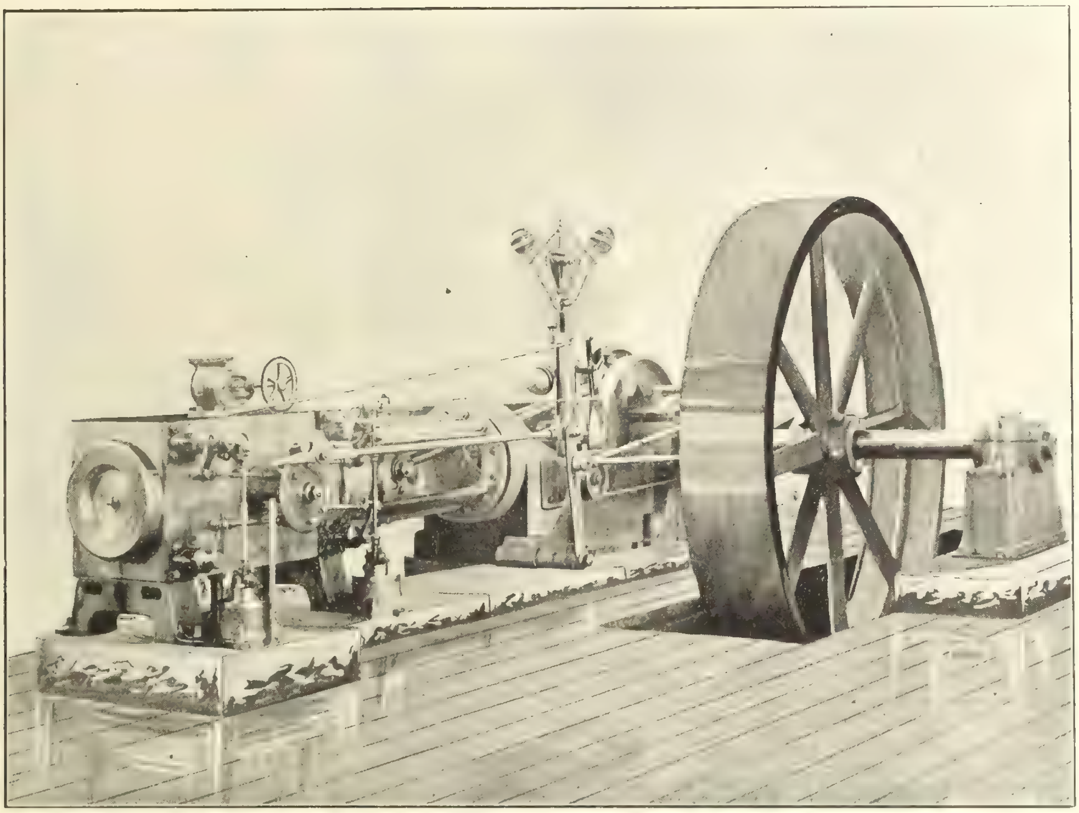
Greenwood

THE JENCKES CORLISS ENGINE



The above illustration shows one of our smaller sizes of the Jenckes-Corliss Steam Engine, with single eccentric and Tangye Bed. We make these engines in all sizes from 12x30 upwards, in simple, cross compound or tandem compound styles, and condensing or non-condensing. The majority of the asbestos mines at Thetford and Black Lake have these engines installed there for power and lighting purposes, and we will be pleased to refer inquirers to installations in their own section of the Dominion, where our engines may be seen running.

A catalog of these engines is now being prepared, and applications for it will be carefully fyled, and a copy sent as soon as received from the printers' hands

The catalog will contain numerous pages of matter interesting to steam users, in addition to full descriptions of the various sizes of engines manufactured by us, and will be sent post free to those interested.

WE WELCOME CORRESPONDENCE.

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and
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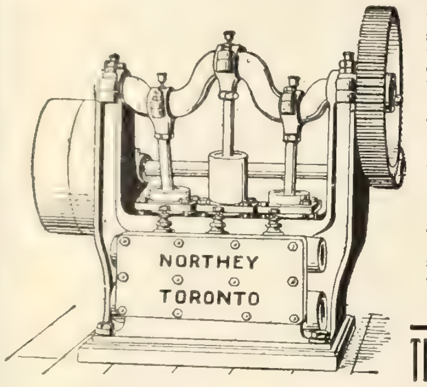
Lead Covered Cables for all purposes

Submarine Cables

WATSON JACK & COMPANY

MONTREAL

THE NORTHEY TRIPLEX POWER PUMP



This pump excels in high class materials and workmanship. A practically constant delivery is assured by the three cranks being placed 120 degrees apart. The pump can be operated conveniently by water power—by belt from engine or by electricity.

We manufacture pumps of every description—for all purposes. Our pumps are standard in Canada for excellent service.

Write for Catalogues.

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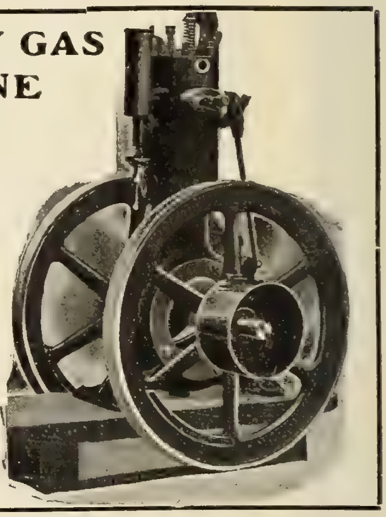
The Northey Gasoline Engine offers the best proposition in the market for cheap, easily handled power. The Engine runs with practically no attention—any boy can manage it—running expenses very light. Ready for work on the minute. Suitable for running independent electric light plants—pumping and elevator plants, etc. This cut illustrates the ½ H. P. size—the only vertical style built; all other sizes are horizontal.

Write for Booklet.

THE NORTHEY CO., LIMITED, 970 King Street Subway TORONTO.



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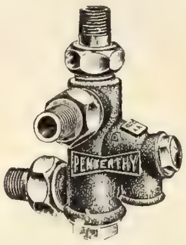

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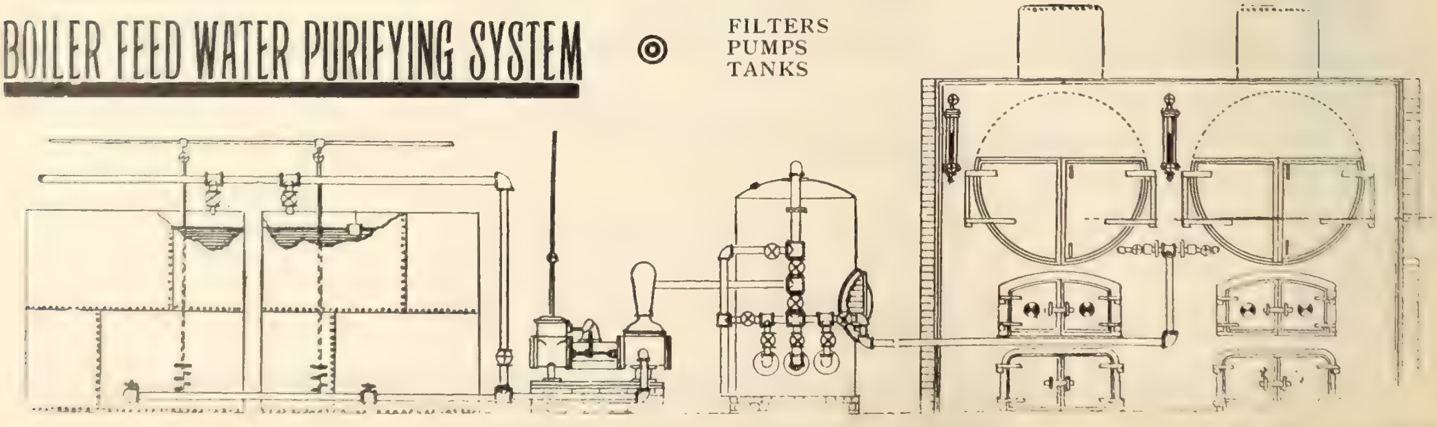

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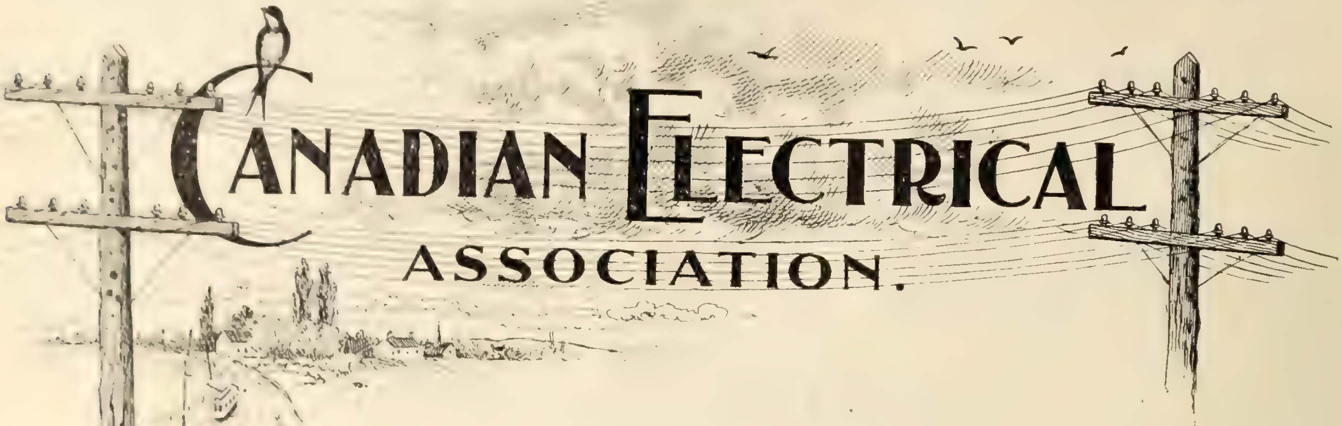
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. JUNE, 1903 No. 6.

King Edward Hotel, Toronto.
HEADQUARTERS FOR THE C. E.A. CONVENTION, JUNE 10th, 11th and 12th.
[See Programme on Following Page.]



CONVENTION PROGRAMME

Convention Headquarters—King Edward Hotel, Toronto.

WEDNESDAY, JUNE 10.

10 A. M. Meeting of Executive Committee.

11 A. M.—Opening of Convention in Assembly Hall, King Edward Hotel.

Address of Welcome by the Mayor of Toronto.

President's Address.

Reading of Minutes.

Reports of Secretary-Treasurer and Committees.

General Business.

Paper: **"Long Distance Transmission."**
By Mr. Paul Lincoln, Pittsburg, Pa.

Question Box.

THURSDAY, JUNE 11.

10 A.M.—Papers:

"Individual Electric Drive and its Relation to the New Shop Methods."
By Mr. R. T. Lozier, Cincinnatti, O.

"Some Points Relating to Submarine Power Cables."
By Mr. G. U. G. Holman, Quebec

2 P.M.—Papers:

"Single Phase Alternating Motors as a Means of Increasing Station Earnings."
By Mr. W. A. Layman, St. Louis, Mo.

"Transformers for High Voltage Transmission Lines."
By Mr. J. W. Farley

Question Box.

General Business.

FRIDAY, JUNE 12.

Selection of Place of Next Meeting.

Election of Officers.

Unfinished Business.

SOCIAL FEATURES

WEDNESDAY, JUNE 10th.—4 P. M.—Tally-Ho drive to points of interest in the City, by courtesy of Canadian General Electric Co.

8 P. M.—Excursion by special steamer and Band Concert at Toronto Island.

THURSDAY, JUNE 11th.—4 P. M.—Visit by special cars to the works of the Canada Foundry Co., by courtesy of the Company.

9 P. M.—Annual Association Dinner, King Edward Hotel.

TRANSPORTATION AND HOTELS.

Persons attending this Convention should purchase a full fare one way ticket to Toronto, and get from the ticket agent from whom they buy a certificate of purchase. This certificate when signed by the Secretary of the Association will entitle them to return at one-third fare over the G.T.R. or C.P.R.

For persons attending the Convention who may desire before returning home to visit Niagara Falls, a special return rate of $1.25 has been granted by the Niagara Navigation Co., GOOD FOR SATURDAY THE 13th INST. ONLY. Tickets must be purchased at the head office of the Company, 54 King Street East, Toronto. Special permission to inspect the power development works at Niagara Falls, Ont., has been arranged for.

The management of the King Edward Hotel, which will be Convention Headquarters, have granted a special rate of $1.50 per day and upwards, European Plan, and $3.00 per day and upwards, American Plan.

Seven years ago the City of Toronto was, for the second time, honored by a convention of the Canadian Electrical Association. On June 10th, 11th and 12th next that honor will be repeated. In the intervening time the Association has grown to be a much larger and more important body. That the electrical fraternity and citizens of Toronto will fittingly welcome and entertain the visitors on the occasion of this convention may be taken for granted, for Toronto, besides being the Queen City of the West, may also be termed the "Convention City."

If to the interesting programme of business and social features which have been provided, are added the many attractions possessed by the Provincial Capital every possible inducement to a large attendance would seem to have been secured. In anticipation of the largest attendance on record, the local committee, under the chairmanship of Mr. A. B. Smith, are rapidly concluding arrangements which will ensure to all members and visitors a pleasurable and profitable gathering. The scope of the papers to be presented is such as should interest all branches of the electrical industry. The banquet to be held in the magnificent new King Edward Hotel will be a brilliant event, and any of the members who may not attend will miss a golden opportunity of broadening their knowledge and business and social connection.

From whatever point the city of Toronto is viewed, it presents elements of attractiveness. The streets are broad and splendidly paved; the residences and public buildings are as fine as can be found in any city of its size in America; there are several spacious and picturesque parks; and what is of great importance, an electric street railway system second to none in America, of which particulars are given elsewhere in this issue.

The two principal public buildings are the Parliament Buildings in the Queen's Park, and the City Hall.

The semi-public buildings of the first rank include the University of Toronto, located to the west of the Queen's Park, Osgoode Hall on Queen street west, McMaster Hall on Bloor street, Upper Canada College at the head of Avenue Road, the Normal School on Church street, School of Practical Science on College street, in addition to many others of lesser importance.

The new King Edward Hotel, which will be the Convention Headquarters, has just been opened. Erected at a cost exceeding one million dollars, it is beyond doubt the most palatial and handsome hostelry in Canada, and excelled by few in the United States. The equipment is of the finest and includes a private telephone system and an electric light plant, of which an illustration is shown on another page.

MR. B. F. REESOR,
President Canadian Electrical Association.

The absence of water power in the immediate vicinity of Toronto is responsible for the employment of electricity to a lesser extent than in many other cities of equal commercial importance. This, however, promises to be remedied in the near future by the introduction of electric power from Niagara, when there will doubtless be a rapid growth in the number of motors used by manufacturing concerns. The lighting business in Toronto, on the other hand, is very large and is supplied by the Toronto Electric Light Company and the Incandescent Light Company from steam-driven plants. There are also a number of isolated electric plants throughout the city, some of which are described in this number.

OFFICES OF THE CANADIAN GENERAL ELECTRIC COMPANY.

The offices of the Canadian General Electric Company occupy the entire building, Nos. 14 and 16 King street east, Toronto, and are conveniently situated in the centre of the business district of the city. The building is a four-storey one, with a total floor space of over 25,000 square feet. It is equipped throughout with modern facilities and a completeness of detail particularly suitable for enabling the company to meet the growing demand and better serve the wants of their customers throughout the Dominion.

On the ground floor are situated the general manager's office, board room, offices of the executive officials, and the general offices.

MR. J. W. CAMPBELL,
Chairman Dinner Committee C. E. A. Convention.

On the first floor is a nicely arranged show room and a display of samples representing a wide range of electric light, power and railway material, and general supplies, including switchboards, station and portable measuring instruments, motors, transformers, enclosed arc lamps, fan motors, electric cooking and heating appliances, and numerous other devices, many of which are shown in operation. Those who are directly or indirectly connected with the electrical industry will find a visit to this show room of much interest.

The warehouse is also located upon the first floor and includes the second floor and basement, with a total floor area of about 17,000 square feet. A large and well assorted stock of staple supplies and material is carried. Each floor of this department is connected by a private warehouse telephone system.

The third floor is occupied by the agency department, and the business and executive offices of the Canada Foundry Company, Limited, which is controlled by the Canadian General Electric Company. The fourth floor is occupied by the engineering staff and is laid out in general offices, drafting, designing and testing departments.

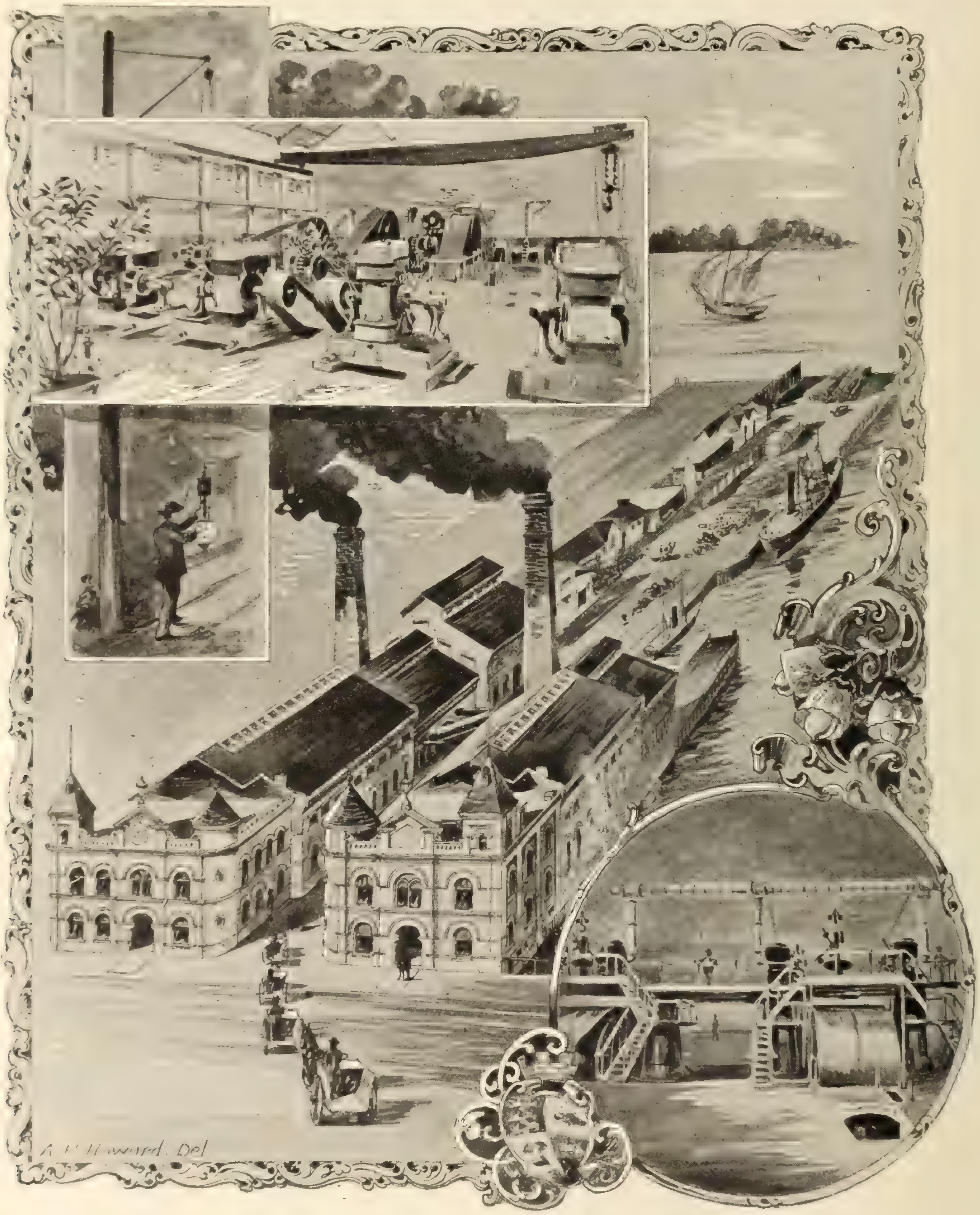
All of the different departments and floors are rendered easy of access by means of electric passenger elevators. Among other salient features of the establishment may be mentioned a local telephone system with a central office in the building, thus enabling every department to have direct communication with each other as well as to outside points. A long distance telephone and two telegraph offices (the company having its private wires to the works at Peterboro and at Davenport) are also conveniently located in the general offices.

We might go on indefinitely dealing with the innumerable details which go to make up the many valuable appurtenances and conveniences of these offices. Mention might be made, however, of the fact that most of the building is lighted by C. G. E. 5-ampere direct current enclosed arc lamps. This system, which is generally conceded to be one of the best means of artificial lighting, is most satisfactory.

Land has been purchased for new offices and show rooms to be constructed at the corner of King and Simcoe streets. The plans show a commodious and handsome building in keeping with the progressive policy of the company.

TORONTO ELECTRIC LIGHT COMPANY.

The power house of the Toronto Electric Light Company, at foot of Scott street, is second to none in Canada. Upon the destruction by fire of the arc lighting station in February, 1897, steps were taken to rebuild this portion, as well as to improve the entire plant, the result being that modern fire-proof structures, equipped with up-to-date apparatus for arc and incandescent lighting and for power, are now to be found.



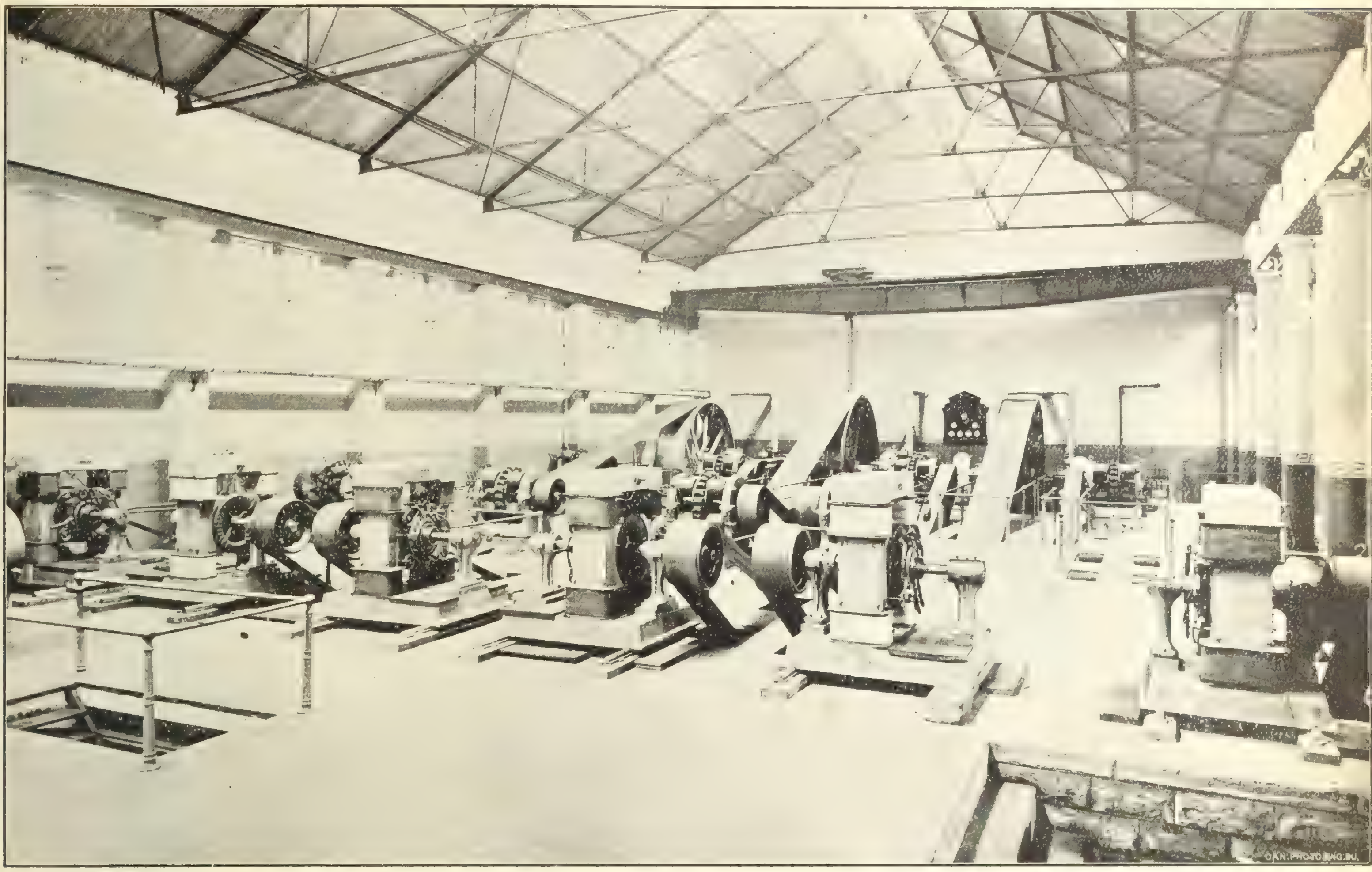
Toronto Electric Light Company—General View of Works.

The illustrations which we present are from photographs taken upon the completion of the reconstruction in the spring of 1898, since which time large additions have been made both to buildings and plant. The foundations of the buildings are of stone and concrete, and the superstructure largely of steel. There is absolutely no wood or any combustible substance used in any part of the construction. The works cover an area of 20,000 square feet and are located on the water front, rendering a supply of coal easily obtainable.

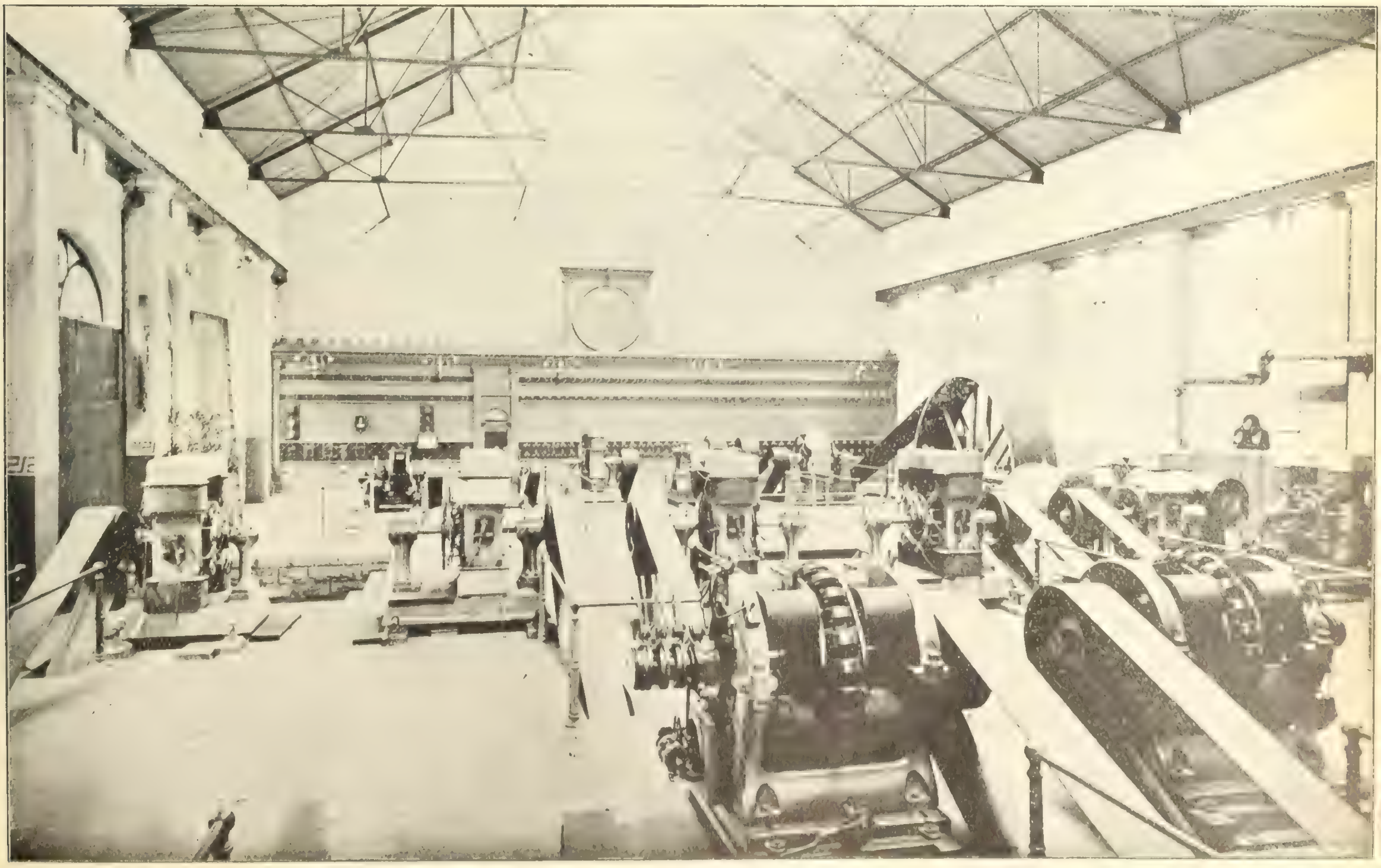
The foundations for machines consist of solid beds of concrete about three feet in thickness. The shafting throughout the works is all extremely heavy and runs in self-oiling bearings of the latest designs.

Arc light station No. 1 is illustrated by photographs taken of each end from the centre of the building. The machines include eight Brush arc dynamos of 125 lights each, and eight of 125 lights each and six of 35 lights each of the Toronto Electric Light Company's own make.

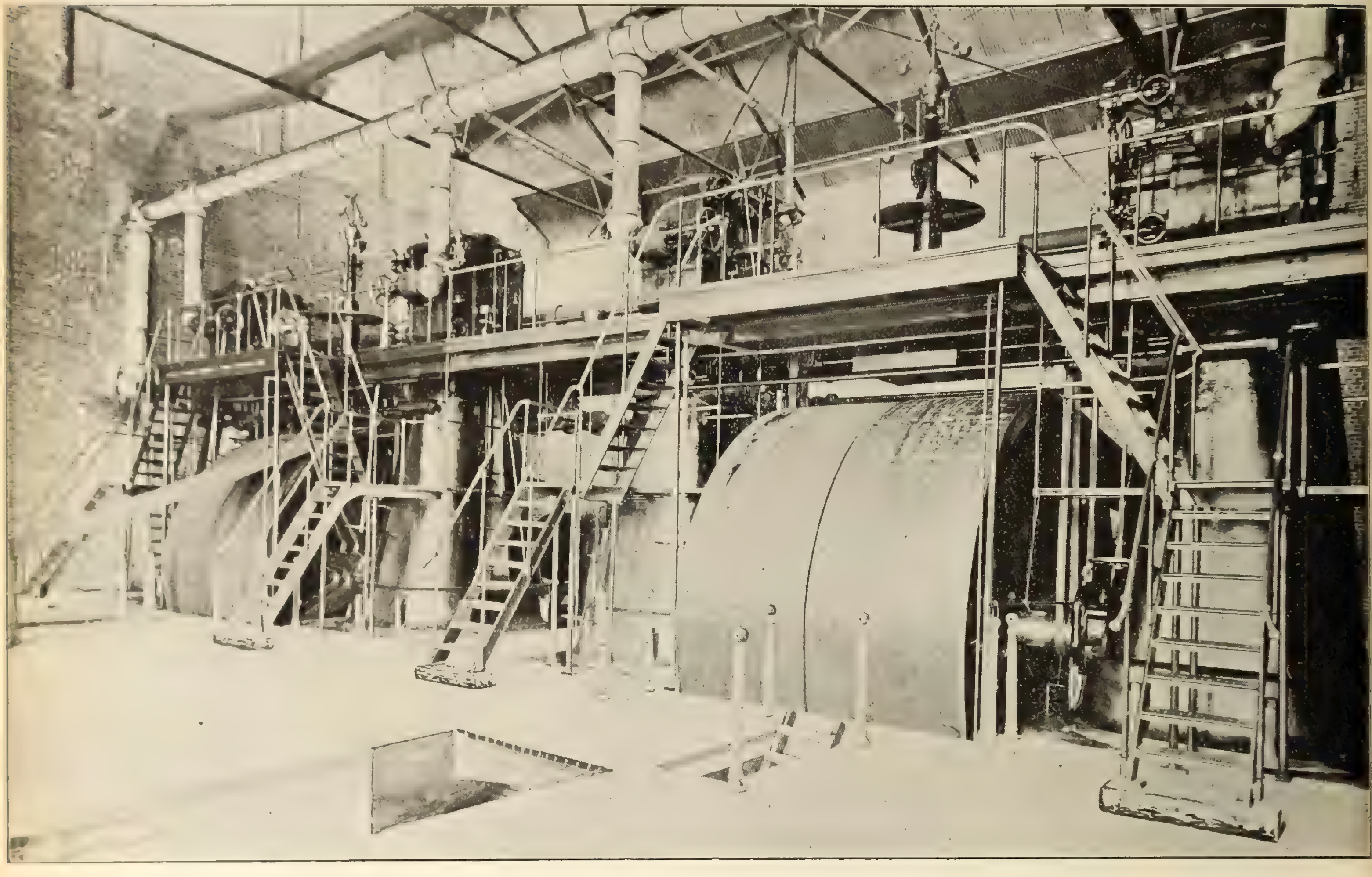
At one end of the station will be seen the arc light switchboard, which is built of pressed brick with terracotta trimmings and is surmounted by a clock driven by electricity. Each arc circuit has ampere meters on the face of the switchboard large enough to be seen from any part of the room, and behind the wall there is a slate shelf for standard ammeters, which can be



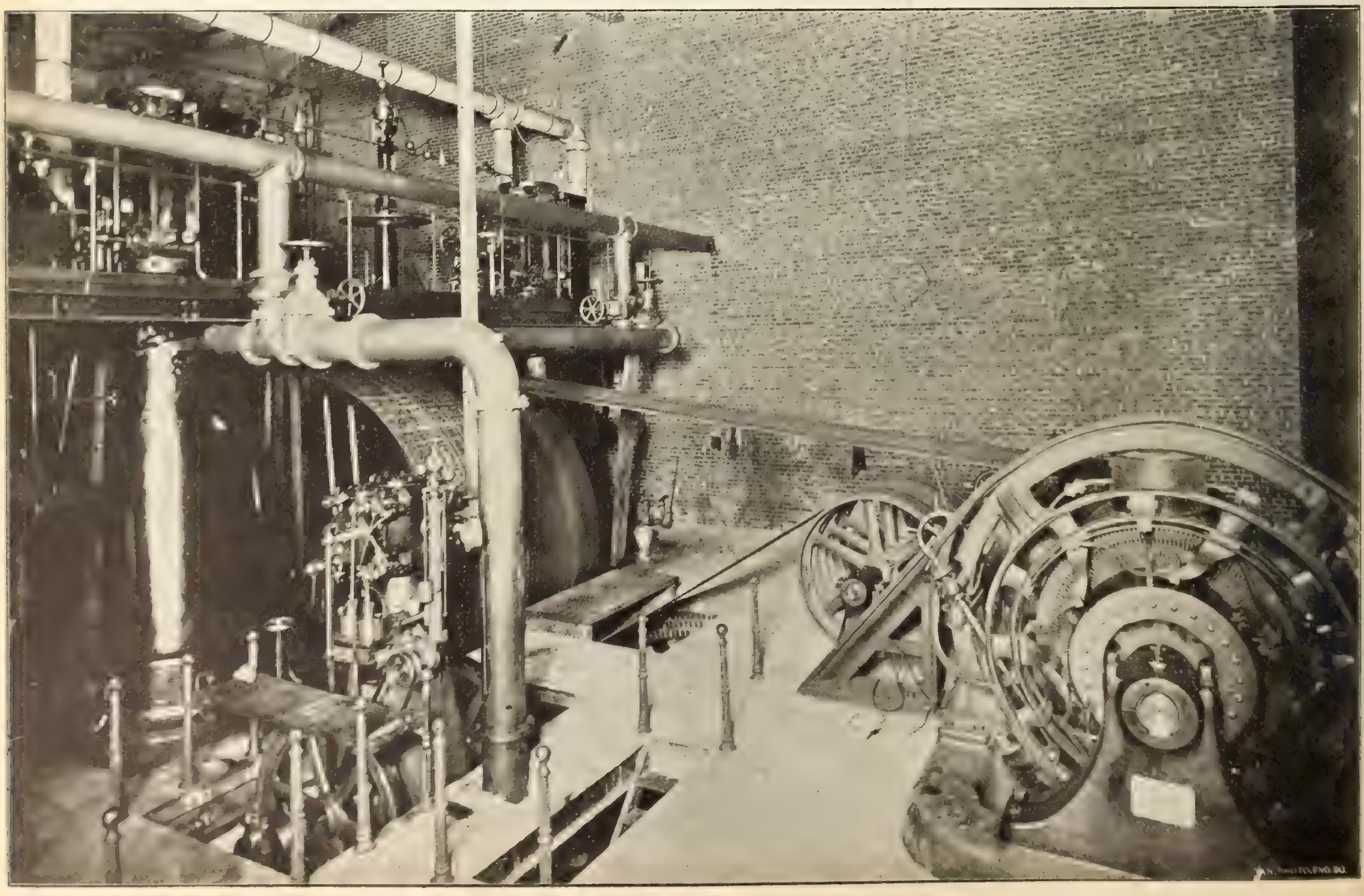
Toronto Electric Light Company—Engine End of No. 1 Arc Lighting Station.



Toronto Electric Light Company—Switchboard End of No. 1 Arc Lighting Station.



Toronto Electric Light Company—3,000 h.p. Engines in No. 3 Station.



Toronto Electric Light Company—Direct Current Generator, 250 Volts, 500 K. W.

plugged into any circuit desired, and also polarity indicators to ensure the currents flowing in the proper direction.

In addition to the equipment herewith illustrated, there was installed in No. 1 station two C. G. E. multipolar power generators of 500 k.w. each and two of 100 k.w. each.

Station No. 2 contains a double-tandem upright Corliss engine of 1,000 horse power capacity, with a fly wheel of 60 inches base, and the general distributing switchboard for all the output of current for power and incandescent lighting purposes. There are now being installed a Robb-Armstrong engine of 550 horse power, to be direct connected to a 500 k.w. Canadian General Electric multipolar power machine.

Station No. 3, as illustrated, is equipped with two pairs of upright Corliss engines of 1,000 h.p. each, and four dynamos—two of 500 k.w. capacity, 250 volts, for motive power purposes, and two alternators of 450 k.w. capacity each, all of the C.G.E. make. The last illustration shows a direct current generator. In this view may be seen one of the automatic cut-off air pumps and condensers which are used throughout the installation. Within the past three years, the equipment of this station has been considerably enlarged. In the fall of 1901 there was installed another engine of 1,500 horse power capacity, manufactured by the Polson Company, of Toronto. This engine was put in operation just in time to take care of the heavy load incident to the visit of the Duke of York, and for that reason is called the "Duke of York". It is of the vertical type and weighs about 200 tons, the fly wheel alone weighing forty tons. The cylinders are 56 inches in diameter. The bearings throughout are water-jacketed, thus insuring coolness in operation. The engine is connected to a 500 k.w. C.G.E. multipolar generator and a 450 k.w. C.G.E. alternating generator. In addition there are now in course of installation in No. 3 station two Polson engines of 550 horse power each, to be direct connected to a 500 k.w. multipolar generator and a 400 k.w. alternator of the same make.

Toronto Electric Light Company—Office Building.

The additional power required has made it necessary to extend the boiler house. This is now being done, the intention being to install boilers of 2,500 horse power capacity from the works of the Canadian Heine Boiler Company, Toronto. A new smoke stack is also under construction. The company manufacture their own arc lamps, switchboards and instruments, having a large machine shop for the purpose.

Mr. J. J. Wright,
Manager Toronto Electric Light Company,

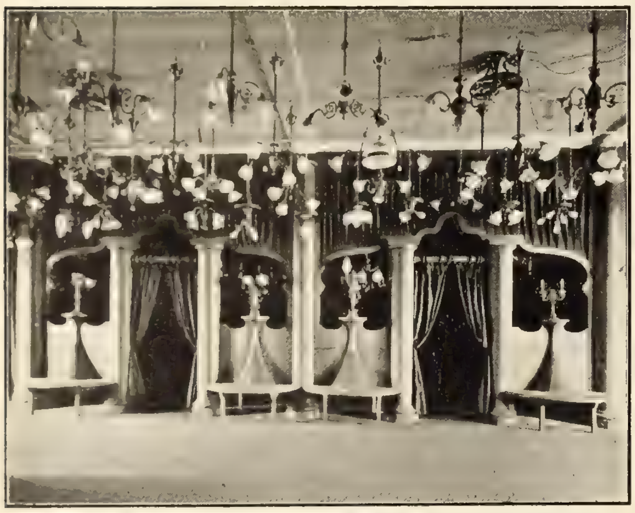
The company recently erected a splendid up-town office building at 12 and 14 Adelaide street east. It is a four-storey brick and stone structure, with a frontage of 51 feet and a depth of 140 feet. This building contains the general offices of the company, the meter department, and show-rooms. It is spacious and nicely fitted up, and is probably the finest building of its kind in Canada. The office of the general manager located to the left of the entrance, and that of the secretary to the right. The show rooms on the second floor are beautifully furnished, the stock carried including a range of electric and combination gas and electric fixtures of handsome design.

Mr. W. A. Martin,
Secretary Toronto Electric Light Company.

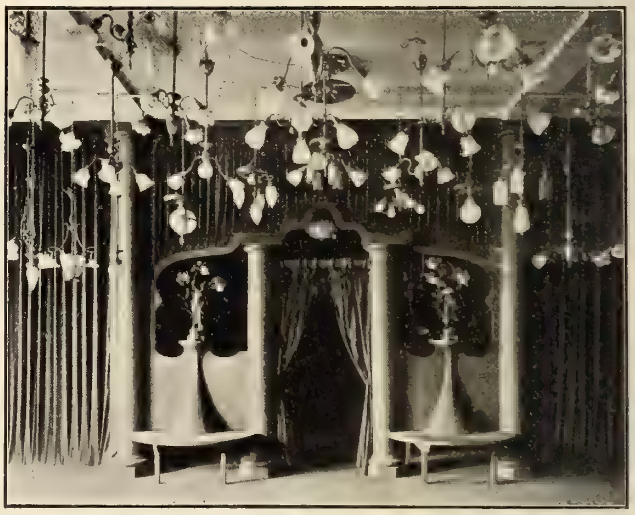
The general manager of the company is Mr. J. J. Wright, and the secretary Mr. W. A Martin. Both the power house and the office building of the company are of a very interesting character and would well repay a visit by anyone interested in such matters. The officials always extend a cordial welcome to visitors.

General Office.

General Manager's Office.



Main Showroom.



Main Showroom.

Combination Showroom.

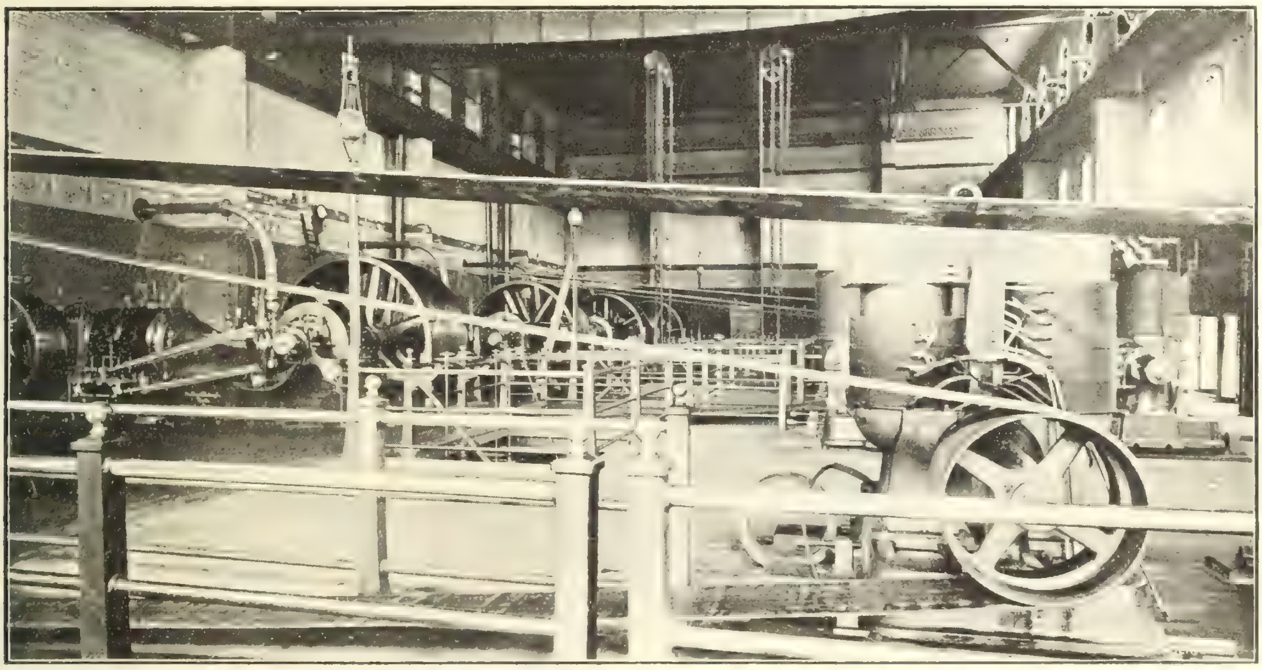
Ceiling Lights Showroom.

VIEWS IN THE OFFICES AND SHOWROOMS OF THE TORONTO ELECTRIC LIGHT COMPANY.

THE TORONTO STREET RAILWAY.

In few cities of America can there be found a more complete and satisfactory railway system than that which has been provided for the citizens of Toronto. One of the first in Canada to be converted into an electric road, it has been steadily improved from year to year, until to-day it stands almost pre-eminent among the electric roads of the continent. The franchise is held by the Toronto Railway Company, of which the officers are: President, William Mackenzie; vice-president, James Ross; general manager, E. H. Keating; superintendent, James Gunn; comptroller, J. M. Smith; assistant superintendent, Ewen Mackenzie; secretary-treasurer, J. C. Grace.

The power house is a brick and stone structure located at the junction of Frederick and Front streets. What is designated as power house No. 1, which contains the original installation, is 137x122 feet, and is divided from power house No. 2 by an 18-inch brick wall with iron doors.



Toronto Railway Company—Engine Room of No. 1 Power House.

POWER HOUSE NO. 1.

The boiler room in power house No. 1 has a trussed roof, leaving it free from post or pillars of any kind. The roof is 52 feet from the floor. The steam equipment consists of twelve 72-in. x 18 ft. boilers, made by the Polson Iron Works, of Toronto, and containing seventy-two 4-in. tubes each. Feed water is taken from the hot well of No. 2 engine room, at the condensers.

The engine room has also a trussed roof, with ceiling 44 feet high. The power equipment consists of four Armington & Sims engines of 500 h. p. each and one of 400 h. p. The four first mentioned were especially manufactured for this plant and have each two driving wheels 25-in. x 9 ft. placed between the high and the low pressure cylinders. The engines are so piped that they can be run non-condensing, and while in this condition with the load on can be connected with the condensers without stopping or throwing off any load. The condensers take water through a 30-in. steel pipe from the lake, a distance of 620 feet.

The engines are connected, by means of leather belts, with nine 200 k. w. Edison generators. All the cabling and wiring is taken down through the floor and carried separately to the switch-board. The latter has an ornamental front. The frame is of wrought iron and the facing of enamelled slate slabs finished in polished cherry. The ampere meters are of the Edison type and the volt meters and circuit-breakers of the Westinghouse type. Each feeder has an ampere circuit-breaker and a two-way switch used for high and low pressure in cases of emergency. Below the switch-board in the basement is a tank lightning arrester. Each of the eleven feeders at the point of entrance to the building is also protected with a Wason four-fuse lightning arrester.

The generators are placed upon very heavy cast-iron arches supported on brick walls beneath the floor of the power house and are insulated by eight inches of wood flooring.

POWER HOUSE NO. 2.

In size and construction No. 2 power house is a duplicate of No. 1. It contains the machinery of more recent installation which became necessary on account of the demand for increased power. The boiler room contains six Scotch marine boilers nine feet nine inches in diameter and 14 feet in length, of 400 horse power each, equipped with Green economizers, two Scotch marine boilers of ten feet four inches diameter and eighteen inches long, of 500 horse power capacity each, and two Babcock & Wilcox boilers of 350 h. p. each, all equipped with Jones underfeed stokers. The engine equipment consists of four cross-compound Corliss engines of 1,200 indicated horse-power each. One of these was supplied by the Laurie Engine Company, of Montreal, and the other three by the Bertram Engine Works Company, of Toronto. They drive two generators of 850 k. w. each, and two of 800 k. w. each, three of which were supplied by the Canadian General Electric Company, of Toronto, and one by the Siemens & Halske Company, of Chicago. The switch-board is equipped with four 2,500 ampere automatic circuit-breakers for controlling the generators, three 5,000 ampere meters which show the total output of the power house, connected to heavy bus-bars, and automatic switches for each cable connection on to the street, also one 10,000 ampere C. G. E. watt-meter.

OTHER BUILDINGS.

Adjoining the power house is the motor shop, 228x 105 feet, with tracks running through from Sherbourne to Frederick streets. The tracks are fitted with the necessary pits, etc., for their entire length. The armature room, 26x228 feet, is located on the second floor, also the drafting room 26x30 feet. The machine shop 50x60 feet, and blacksmith's shop 40x50 feet, adjoin the motor shop. There is also a brass foundry and moulding shop in conjunction with the motor shop buildings.

The buildings are heated by the Sturtevant fan system of forced draft, the necessary apparatus for same occupying a space 16x20 feet. Car barns across the street are also heated from this plant by means of underground pipes.

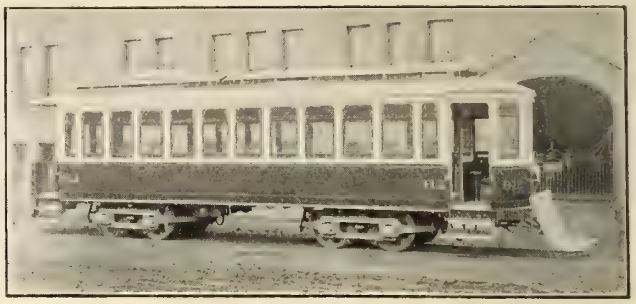
The company has eight large car barns; three are situated on King street east, one being of brick, two storeys, 224x194 feet, and the other two of galvanized iron and wood, their dimensions being 626x66 feet and 320x66 feet. At Yorkville are situated two barns, one being 242x100 feet and of brick, and the other 200x 98 feet and of galvanized iron and timber. Another barn is located at the corner of Dundas street and Howard Park avenue. It is a brick structure, 398x 100 feet. The seventh is located on Roncesvalles avenue, just north of Queen street, and is of brick, 263 x139 feet. A building east of the power house, 268x 68 feet, and three storeys high, is used jointly for storing cars and as a general store room. The lower flat of the car building shops, a three storey building 137x 108 feet, at the corner of Front and Frederick streets, may also be used for storing cars, the two upper storeys being for car building purposes.

Toronto Railway Company—Power House.

About one year ago the stores department was moved into a new building specially fitted up for the purpose. This department is a striking example of convenience and neatness and may be said to be a model storeroom for street railway purposes.

ROLLING STOCK.

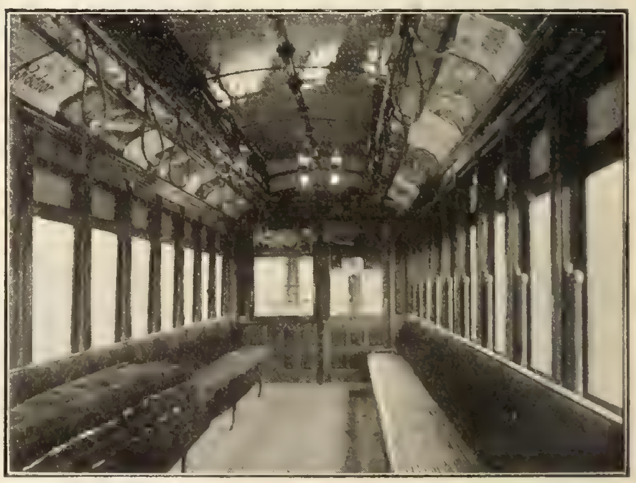
The rolling stock owned by the company comprises 296 closed motor cars, 260 of which are equipped with two-motor equipments and 36 with four-motor equipments, 196 open motor cars, with 98 closed trailers and 120 open trailers. Some of these cars are equipped with the Momentum brake. The company also operates the Toronto & Mimico Electric Railway, which has three double truck closed cars and four large open cars with a seating capacity each for 108 persons. The Scarboro Electric Railway is also operated by the Toronto Railway Company. Its rolling stock consists of four closed single truck cars with double motor equipment, and three open, single truck cars with double motor equipment.



Toronto Railway Company—New Convertible Car.

The company have in operation on the Belt Line a new convertible car. It is designated No. 912, and can be converted from a closed to an open car and vice-versa in less than one hour.

The first illustration shows the side of the car on which the panels are taken out in order to convert it into an open car. It should be stated that all the cars of the Toronto Railway Company run in one direction, not being double enders. The interior view shows the cushions removed from one of the longitudinal seats, which are in sections so that the same seats can be used when converted to an open car. The management point with pride to this car, which, they claim, possesses many points of superiority over the convertible cars in use in American cities. The company intend constructing a number of cars of this description at once.



Toronto Railway Company—Interior New Convertible Car.

The company have in operation within the city limits a total of 100 miles of track, while the Mimico road is six miles in length and the Scarboro road five miles. Of the city trackage 80 miles are laid on concrete and ties, 15 miles on concrete and tie bars without ties, and the balance on gravel with ties, but without concrete. Standard 73-pound rails are used throughout.

During the past year the company cast-welded the rails on Church street, from King to Bloor streets, making in all a distance of over two miles. They are at present laying new tracks on Front street, from Simcoe to Bathurst and to King street, making a distance of 1¼ miles of single track, the New York standard 90-pound girder rail laid on concrete, with tie bars, being used. This track will have cast joints instead of fish plates and bonds. Preparations are also being made to renew the present tracks on Yonge street, from Front to Queen streets, using the 90-pound New York standard rail above referred to. The company are also engaged in putting on 5,000 cast-welded joints on the tracks on different streets, to overcome the loss of current through insufficient bonding of joints. This system of welding joints has been found most economical. The records of the company show that on cast welded joints, properly installed, the resistance across 17 inches of the joint is only equal to the resistance of 14 inches of solid rail.

Mr. Wm. Mackenzie,
President Toronto Railway Company.

Mr. E. H. Keating,
Manager Toronto Street Railway.

The overhead construction is now of the best possible character. Within the last six months the overhead system has been largely remodelled and especially at intersections, where there have been installed switch pans and diamond crosses and frogs. There has also been adopted a new style of feed-in ears from the cables to the trolley wire, while equalizing spans between the trolley wires have been put on at stated distances throughout the entire system. This has much improved the overhead work.

In the centre of the city wooden poles are rapidly being replaced by standard iron poles, which improve the appearance of the street construction very much.

A staff of five men is employed on emergency calls, and when it is stated that for the past four months these calls have not averaged one a day, the efficiency of the street plant will be understood. There is also a regular repair staff of three men on a tower wagon constantly keeping the overhead work in repair, whilst the new work is attended to by four men and a tower wagon, all under the supervision of one foreman.

The employees of the company number about 1,300.

Mr. Jas. W. Gunn,
Superintendent Toronto Street Railway.

During the year 1902 over 44,000,000 passengers were carried and 16,000,000 transfers given.

The head office of the company is situated at the corner of Church and King streets.

COST OF SUPERHEATED STEAM.

The cost of a superheated steam plant was referred to as follows by Mr. R. Lenke in a paper on superheated steam read before the International Engineering Congress at Glasgow. Steam engines with superheated steam, he said, use on an average 30 to 40 per cent. less steam than engines of the same type using saturated steam. Consequently, boilers could be made 30 per cent. smaller, and the difference in price would nearly cover the cost of the superheater. For the same steam consumption the superheated steam engine was the cheaper, as it could be worked with a lower boiler pressure; instead of a compound engine with saturated steam, a single cylinder engine with superheated steam could be used. He called attention to the fact that superheated steam can travel at 30 to 40 per cent. higher speed through steam ports than saturated steam, which consequently means smaller steam pipes throughout.

Thornbury, Ont., has carried a by-law granting a loan towards the establishment of a gasoline engine and foundry works.

The city council of Montreal have appointed a committee to report upon a proposition to place all telegraph, telephone and electric light wires underground in one common conduit.

THE METROPOLITAN ELECTRIC RAILWAY.

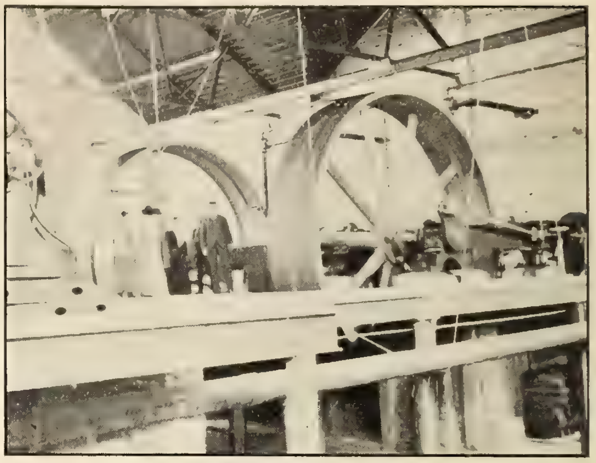
The power plant of the Metropolitan Railway Company furnishes the only example of double current generators and rotary converters to be found in Toronto or vicinity. The road extends from the C. P. R. tracks at North Toronto to Newmarket, a distance of 30 miles, passing through a number of small villages. The power house is located at Bond Lake, about 20 miles from the southern terminus of the road. It is located in a valley, the top of the building being but a few feet above the level of the land, thus providing an easy means of obtaining a supply of water for condensing purposes without the necessity of pumping.

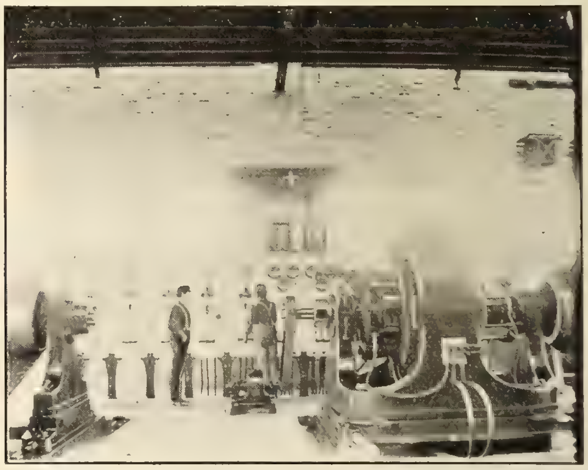
MR. J. W. MOYES,
Manager Metropolitan Railway.

The power house is a white brick structure, with stone foundation and iron and slate roof. The boiler room is situated directly to the south of the engine room and is separated therefrom by a brick wall.

The boiler plant consists of four steel return tubulars of the Goldie & McCulloch Company's make, their combined capacity being 700 horse power. Water is fed to the boilers by two duplex boiler feed pumps manufactured by the Northey Company.

The engine equipment consists of two cross-compound Wheelock condensing engines, furnished by the Goldie & McCulloch Company. They have a capacity of 350 h. p. each operating at 86 revolutions per minute. Each engine drives a 275 k. w. A. C. D. C. 60-cycle, three-phase multipolar generator connected by means of a 42-inch belt. The generators operating at 600 r. p. m. give 550 volts direct current on one side and 350 volts alternating current on the other. The direct current is turned on to the entire length of raad, and duringthe times of trouble through falling trees, twigs, etc., the entire line is operated by direct current from the Bond Lake power house. The alternating current is delivered to 500 k. w. static transformers situated in the power house and wound for 400 volts primary. It is then stepped-up to a pressure of 16,500 volts and conveyed by the three-wire system a distance of 16 miles, to a sub-station at York Mills, where it is passed through step-down transformers and rotary converters and reduced to 550 volts direct current, at which it is delivered to the entire line.


METROPOLITAN RAILWAY—ENGINE ROOM.


METROPOLITAN RAILWAY—GENERATORS AND SWITCHBOARD.

METROPOLITAN RAILWAY—POWER HOUSE AT BOND LAKE.

The rotary converters in the sub-station are operated at 710 r. p.m. and each is excited on one side by an induction motor of 25 horse power, a synchronizing motor for operating the plant being on the south side. The generators, rotary converters, transformers, and switch-board equipment were furnished by the Westinghouse Company.

The poles for the transmission line are of cedar and set 100 feet apart. No. 4 covered copper wire is used. The trolley wire is No. 2-0 and the feed wire No. 4-0 bare copper, with a feeder into the trolley wire every tenth pole.

The company is well provided with rolling stock, the Canadian General Electric Company and the Westinghouse Company having furnished the motor equipment. For hauling freight a Baldwin-Westinghouse electric locomotive of 200 h. p. is used.

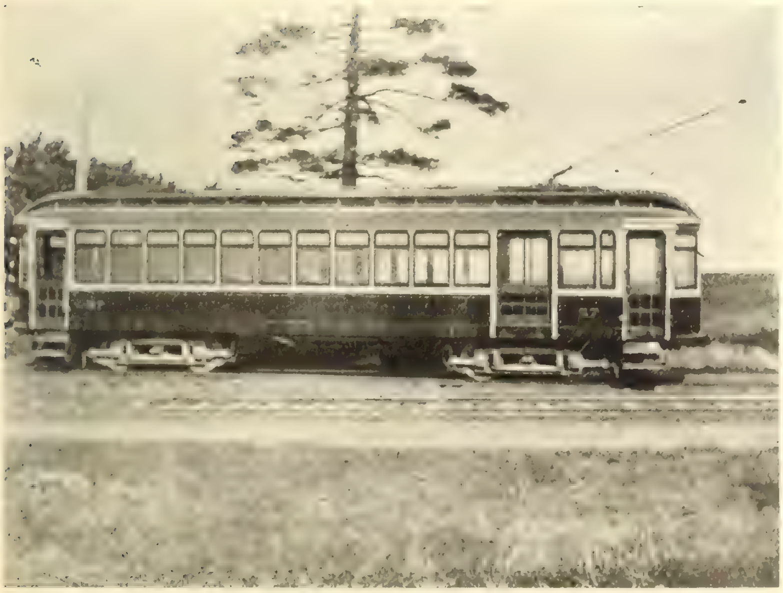
Mr. J. W. Moyes is general manager and superintendent of the road.

The corporation of Coaticook, Que., has purchased the electric light plant for $36,000, and wiassume control in October.

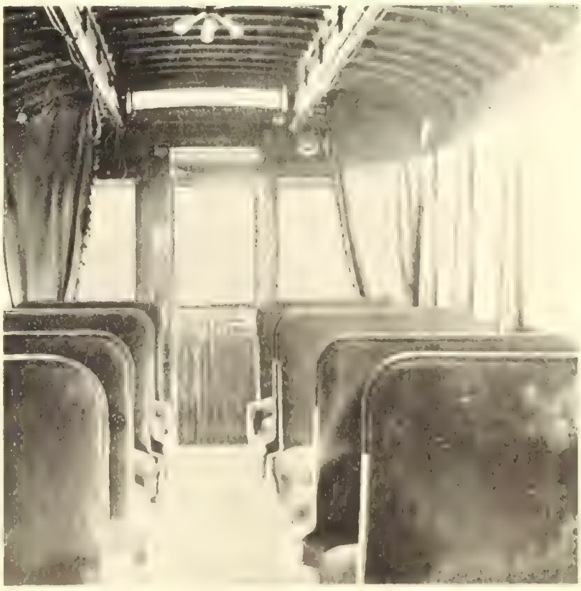
Cars in Snowdrift.

Snowdrift in the Ridges.

View at Thornhill.



One of the Cars, 47 Feet Long.



Interior of One of the Cars.

VIEWS OF THE METROPOLITAN RAILWAY—TORONTO TO NEWMARKET.

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Fan Motors.

The fan motor is a small piece of machinery when it is manufactured and in stock ready for the market, but an immense amount of ingenuity is spent every year in getting out types which can fairly claim to be improvements over those of the previous season. The adjustable swivelling and trunnion frames, capable of directing the breeze to any desired point, were the first improvements. The present practice is tending almost the other way, in that efforts are being made to give a distributed flow of air. This is accomplished in one type by spreading the breeze, which travels in a horizontal instead of a vertical plane, over a cone with a vertical axis. In another design a set of oscillating blades divert the air from side to side; the same result is accomplished by another maker by swinging the fan itself over part of a circle. Still another method is to let the complete fan swing all the way round, which is accomplished by mounting it on a swivel with the necessary current collector rings. Every year sees this little instrument regarded more and more as a necessity rather than a luxury. Would not a vigorous canvass among your customers result in the addition of many of them to your load?

Transpositions.

All wires carrying alternating currents exert effects upon neighboring conductors which tend to disturb the normal voltage carried by the latter, the amount of this distortion, under ordinary practice as to distances apart, amperage, voltage, etc., often being such as to seriously mar the proper operation of the system unless some means of neutralizing these effects be introduced. This disturbing action may take place between the various wires of the same circuit, or between different circuits, and is caused by two distinct phenomena, namely, electrostatic and electromagnetic induction. There is as yet no commercial remedy for the former, but the latter under its more familiar title of mutual induction can be neutralized by the introduction into the line of transpositions, which consist of a change in the relative locations of the various wires on a pole. The question as to the proper number of transpositions necessary, and the best location for them, is a matter for considerable investigation before the line is erected. Transmissions of moderate length and capacity, either three phase three wire or two phase four wire, if symmetrically erected in the shape of an equilateral triangle for the former, and the diagonals of a square for the latter, require no transposition to avoid mutual effects in the lines themselves. Regarding interference to or from neighboring lines, a three phase system would have to be barrelled twice in order to divide it into three equal parts, which would neutralize each other. Similarly a two phase system has to be rotated at three points, the four resulting sections neutralizing each other. The amount of disturbance permissable depends, of course, on the regulation desired; obviously more distortion is allowable on lines supplying principally motors than on those carrying a lighting load; thus, on power lines of moderate size, where different circuits do not parallel each other for more than say, two or three miles, transpositions can often be omitted with advantage. Induction in telephone and telegraph lines is usually taken care of by transpositions in the lines supplying these instruments.

The former device is the much more sensitive to outside influences, and requires as a rule frequent transpositions, though when telegraph instruments are operated on a grounded circuit, there is usually a great deal of interference, which is more likely due to leakage than induction, and which, therefore, cannot be entirely cured by transposing. On the whole, it would seem to be advisable to reduce the number of transpositions to the lowest possible practical limit, wherever possible omitting them entirely. They are a weak point in line construction, always liable to trouble, and if it is subsequently found, due to changes in the load or distribution, that more are desirable, they can then be put in without difficulty.

Transformer Types

The question of a choice between air blast and oil cooled transformers has always been a difficult one, the advocates of both types having many arguments in favor of one style or the other. The use of an artificial draught of cooling air, which can positively be forced through every part of the apparatus, say the air blast men, ensures that the interior of the transformer shall be but little hotter than the outside. To this is made the reply that moving machinery, which requires constant attention, and which may fail at some critical moment, is necessary for the production of this air blast, whereas the oil cooled type is absolutely self contained and possessing no moving parts or accessories, requires but the minimum of attention. On the other hand, the presence of this cooling oil involves the addition of a serious fire risk, which is but imperfectly compensated for by the oil tight brick guard walls which are frequently built round the apparatus. Besides this the type is heavier and therefore costs more than the air blast, both originally and also for freight and handling. To compensate for this, the oil cooled apparatus can be installed in situations where, owing to an exceptionally dusty or damp atmosphere, the use of air blast equipments might be inadvisable. Further, it is claimed that the former is less liable to damage from lightning, as the oil would flow into any puncture which might take place and heal it immediately. Again, there being no opportunity for foreign matter to get into the case, there can be no stoppage of the oil channels, whereas in the air blast type dust and dirt, if not periodically blown out, soon accumulate to an extent sufficient to materially reduce the cooling effect of the air. It will thus be seen that there are a great many points to be looked after when deciding on an equipment, and that a decision can be reached only after due consideration has been given to the advantages and demerits of each type.

Compounding Alternators.

The compounding of alternators to automatically maintain a desired potential at any designated point, irrespective of changes in load and speed, is a most difficult problem which has for years engaged the attention of designing engineers. In direct current work the only factors to be taken care of are the amperage which is being delivered and the speed of the machine, but in alternating circuits a third quantity is encountered, namely, the power factor of the load, which tends to render the regulation of this class of apparatus much more complicated than the former. The first attempts to compound alternators were the commutating machines of the Westinghouse and General Electric Companies, which depended for their regulation on nothing but variations in the amperage, being independent of the speed and the power factor. Later there came the compensated type of the General Electric Company, which was a step in advance in that both power factor and amperage were taken care of, but there existed no means of correction for changes in speed. This company has now brought out a new instrument, the Tirrill regulator, which takes account of variations in all three factors and which would thus seem to be a marked step towards the solution of the problem. The principle used in accomplishing this result is that of using the voltage to be controlled as the main actuating force of the apparatus, which would seem to be the logical method of attacking the question. In outline the apparatus consists of a vibrating contact which when closed short circuits the exciter field rheostat; conversely when this contact is open the rheostat is put back into the circuit. The rate of opening and closing this contact, and therefore the average effect of the exciter field rheostat, is controlled by a coil energized from the voltage which is to be regulated. If the voltage falls, from any reason whatever, the vibrating contact, through a suitable arrangement of mechanism, shortcircuits the field rheostat for a greater length of time, and thus raises the voltage of that machine, which in turn tends to restore the alternating potential to its normal point. In addition to the potential winding on the actuating coil controlling the moving contacts there is provided a current coil which, in series with the load, can be used to give increasing potential as the amperage rises, the degree of compounding being varied by inserting more or less turns of this winding as desired. It will also be seen that the potential winding of this coil can be energized either from the bus-bars of the station or from any desired distributing point by means of pressure wires run back to the power house. The apparatus is self-contained and built for switchboard mounting, and as it entails no change in the machines to be governed, can be applied to existing installations with no outlay other than that for the regulator itself and the necessary winding. This, combined with its simplicity, would make it appear that the device is going to find a large field of usefulness, as the growing use of polyphase plants furnishing both light and power from the same bus bars is continually calling for better voltage regulation, and this in the face of large and sudden variations in both load and speed.

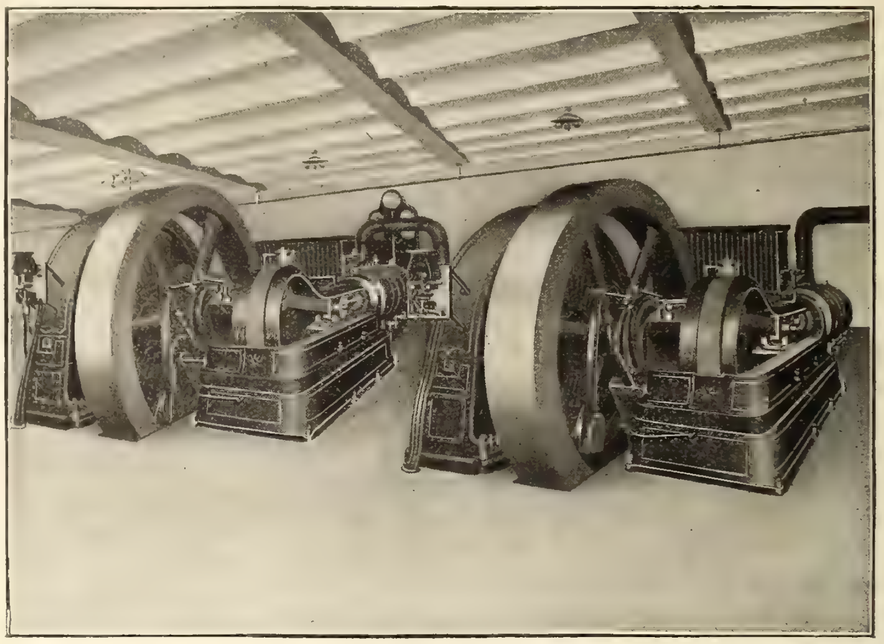
Mr. J. T. Fanning, hydraulic engineer, of Minneapolis, recently made an inspection of the water power of the Kakabeka Falls near Fort William, Ont. He will make a report to the capitalists who are financing the development for the Anglo-American Power Company.

"Burn your name into the public mind" is the axiom of the Edison Electric Illuminating Company of Brooklyn, and by way of aiding merchants to follow it the company furnishes handsome illuminated electric business signs free of cost to those who will pay for current. A fine booklet shows various styles of signs, with estimates of cost per month, and also demonstrates the beauty and advertising value of electric signs by means of views taken in Brooklyn streets. "Solid Comfort or the Matchless Man" is an illustrated booklet enforcing the conveniences of an electrically illuminated home, while several small folders treat of other electrical conveniences.

ELECTRICAL EQUIPMENT OF THE EATON DEPARTMENTAL STORE.

What is beyond doubt the largest private electric plant in Canada is that to be found in the departmental store of the T. Eaton Company, Toronto. Owing to the rapid growth of the store, it became necessary to extend the plant from time to time, until to-day its capacity is upwards of 2,000 horse power. The floor space of the store is equivalent to about 15 acres and employment is given to 4,800 hands. The power plant, as well as all the engineering details of the building, is in charge of Mr. George Thomson, the chief engineer, who has been associated with the company for thirteen years.

The boiler room is 40 x 68 feet in size, with a coal bunker adjoining of a capacity of 300 tons. The boilers are all of the Heine type and include five of 150 h p., two of 410 h.p., and one of 410 h.p. about to be installed. The boilers have automatic feeds and are equipped with Jones stokers. The forced draft apparatus consists of a pair of Robb-Armstrong engines and McEachren fans. The amount of air is controlled by steam pressure by means of a Foster regulator. There are three feed pumps, of Northey make.



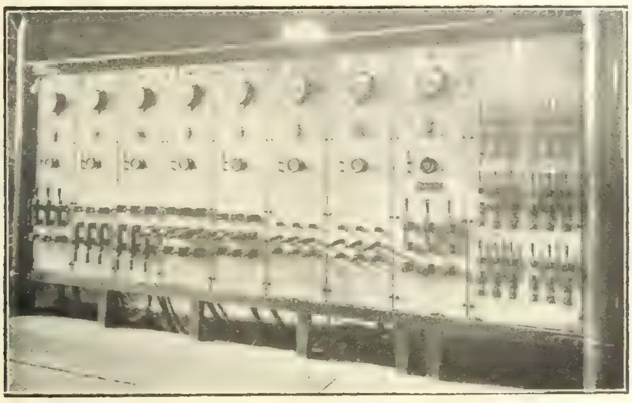
The T. Eaton Company—Pair of Robb-Armstrong Engines.

The generating room is 80x60 feet in size, with concrete floor and a height of 27 feet to the ceiling. Two 225 k. w. C. G. E. generators are coupled direct to two 350 h. p. Robb-Armstrong tandem compound engines 15x26x24 ; four 130 k. w. C. G. E. generators are coupled to four 175 h. p. "Ideal" engines, manufactured by the Goldie & McCulloch Company ; one 50 k. w. C. G. E. generator is coupled to a 75 h. p. 12x12 Robb-Armstrong engine, and one 25 k. w. C. G. E. generator is coupled to a 10x10 Robb-Armstrong engine of 40 h. p. In addition there is now in course of installation a 225 k. w. Westinghouse generator to be direct-connected to a Robb-Armstrong engine, 21x24, of 400 h. p. This engine will be fitted with the new Corliss valve gear, consisting of an eccentric, a steel rocker and straight connection to valve. By means of a special form of rocker arm the valve is moved more quickly at one end of its stroke than the other, the effect of which, it is said, is to give even and regular indicator cards.

The T. Eaton Company—Generators and Engines.

The generator switchboard, show in the illustration, is of marble, 7x18 feet. There are eight generator panels and one distributing panel. Each generator panel contains three single-pole double-throw knife switches, rheostat, Weston ammeter and voltmeter switch. The distributing panel controls the power and incandescent and arc light circuits for the factory building and the stable. The current for the main store is conveyed by means of cables to a distributing switchboard located in a sub-basement beneath the store. The wiring is of the three-wire 220 volt system.

For lighting the main floors of the store arc lamps are used, of which there are upwards of five hundred. The basement of the store, the factory building and the stable are lighted by incandescent lamps, the number now in use being 4,000.



The T. Eaton Company—Switchboard.

In the factory building 1,400 persons are employed. All the machinery is motor driven, there being forty-two motors of a combined capacity of 200 horse power. These are employed largely for operating 1,200 sewing machines for making underwear, skirts, cloaks, costumes, gents' clothing, furs, neckwear, etc., the goods being sold entirely over the counters of the store.

Motors are also employed for driving the blowers for operating the cash system, there being four of 50 h. p. each used for this purpose. Four 6 h. p. motors operate small ventilating fans, while the vestibules are heated by air blown through steam coils by means of motors.

The load on the plant is at times quite heavy, as is shown by the figures for the month of December. The maximum load in that month was 6,050 amperes, the minimum load 2,500 amperes, and the average load 4,190 amperes for a ten-hour run.

The cold storage plant, installed by the Linde British Refrigerating Company, and adjoining the engine room, consists of two 10-ton compressors, coupled to a 12x28 Wheelock engine. The combined ammonia and brine system is used and is believed to give the most satisfactory results. The cold storage room is 100x30 feet, divided into six compartments, and is used for storing meats, poultry, and fresh and preserved fruit, principally for lunch room purposes. Three refrigerators in the meat and grocery section of the store, as well as the soda water fountain and cut flowers, are kept at a proper temperature by means of the refrigerating plant.

The elevators are twenty-two in number, of Fenson make, and hydraulically operated. Fifteen of them are located in the store, five in the factory and two in the stable. The pumping plant for the elevators comprises two compound duplex Northey pumps, 16 x 24 x 16 x 24, and one compound duplex Northey pump 14 x 20 x 14 x 18.

The building is heated by the two-pipe system by means of exhaust steam exclusively.

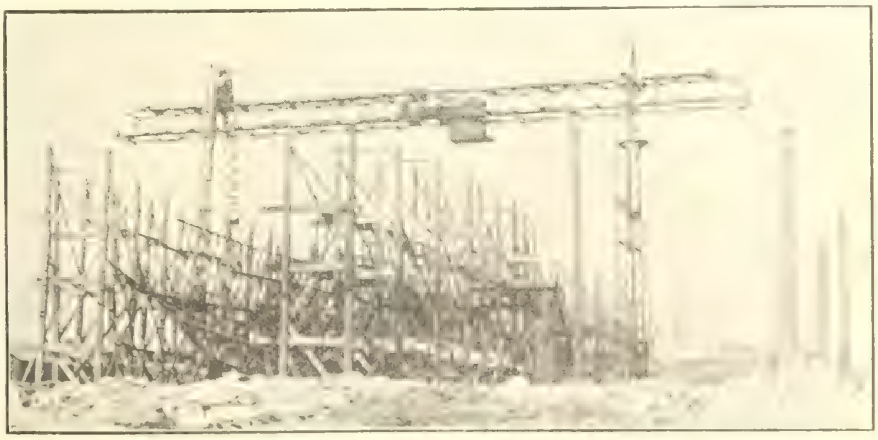
The cash system of this store is claimed to be unsurpassed in America. It is the pneumatic tube process, handled by four No. 7 positive pressure blowers. Each blower takes 56 cubic feet of air per revolution and operates at 120 revolutions per minute, making a total of 26,880 feet of air handled per minute. This air is discharged outside, and, being replaced by fresh air, provides considerable ventilation for the building. There are 203 cash stations located in all sections of the store. The average length of each line is 150 feet, showing that a total of 30,450 feet of brass tubing is required for the cash system.

An interesting conveyor system is employed for carrying parcels from one section of the store to another. The largest of these conveyors is 640 feet long and is used at the present time for mail orders, the rubber belt employed being 30 inches wide. There are three other conveyors for city parcels.

Much attention has been given by the management of the store to a fire protection system. There is a fire alarm system with four stations on each floor. Each building contains an automatic sprinkler equipment, while on each floor there are located fire extinguishers and about 400 feet of hose. There is a well equipped fire brigade of twenty persons constantly ready for duty.

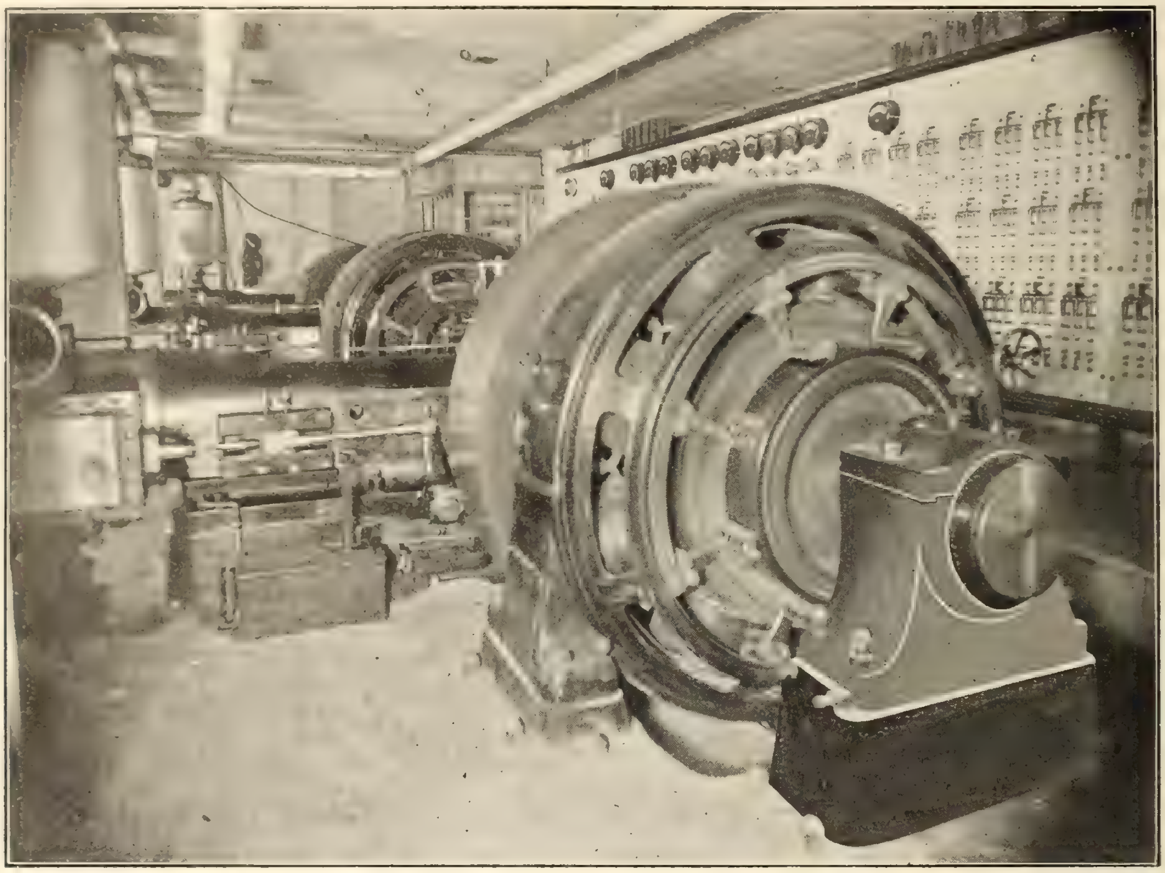
ELECTRIC TRAVELLING CRANE.

The electric travelling gantry crane illustrated herewith is in use by the Polson Iron Works Company, Limited, Toronto, at their ship yards. The rails are 70 feet apart and extend for about 500 feet, so that the steel work for two or three boats under construction at the same time may be readily delivered at the proper place. The boom is 120 feet long and is about 60 feet from the ground. The electric equipment was manufactured and installed by The United Electric Company, Limited, of Toronto, and consists of two 25 h. p. and one 5 h. p. multipolar, "Superior" type motors in weatherproof casings, together with the usual reversible controllers, trolley fittings, etc. The illustration shows two light ships under construction for the Dominion Government for use in maritime waters. The contract for the generators, engines, and flashing devices (two complete outfits for each vessel) has also been awarded to The United Electric Company, and the same company has just installed a motor for the reversible hoist for operating the sheer legs which are used at the Polson Iron Works for placing machinery in vessels and even lifting bodily from the water vessels of considerable size. The Polson Iron Works have greatly increased their facilities and are becoming one of the largest iron works in Ontario. They have lately installed some very heavy machine tools direct driven by U. E. Co. motors; some of these tools being imported from Scotland, and others made by John Bertram & Sons, Dundas, Ont.



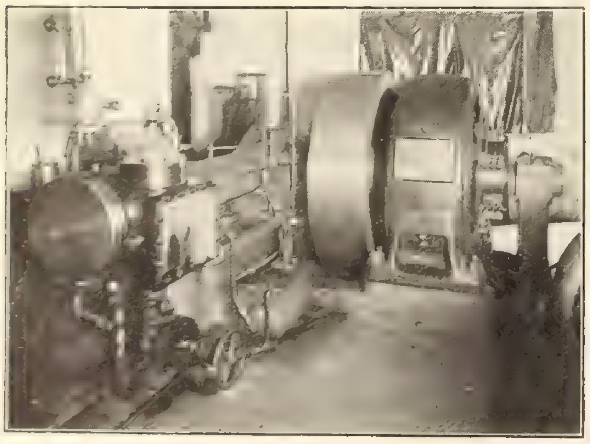
Electric Travelling Crane at the Polson Ship Yards, Toronto.

THE KING EDWARD HOTEL PLANT.



King Edward Hotel, Toronto—Three of the Units.

The new King Edward Hotel is a handsome building, elaborate in its appointments, and containing many features which will interest visitors. Persons attending the C. E. A. convention will probably be most attracted by the electric plant, which is in charge of Mr. Alex. Storer. The boiler equipment consists of four return tubulars of 150 h.p. each, manufactured by the Polson Company. There are two C. G. E. 150 k. w. 220-volt direct current machines operating at 215 r.p.m., one of 100 k.w. operating at 270 r. p. m., and one of 50 k.w. operating at 300 r.p.m., all coupled to Robb-Armstrong side-crank, non-condensing engines, the exhaust steam being used for heating. These are operated on the two outside wires of the three-wire system, the neutral being obtained by motor generator balancing sets, of which there are two of 25 k.w. capacity each.



King Edward Hotel, Toronto—The 50 K. W. Unit.

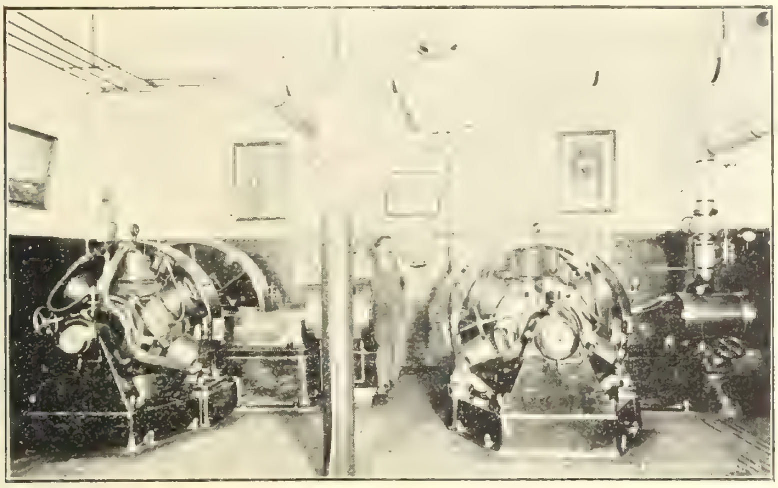
Two Wheelock engines operate the cold storage system and an artificial ice-making plant.

The switchboard in connection with the generating plant is 25 feet long and nine feet in depth. It is of marble, with marble pillars at each end and brass grille work surmounting it. It is set upon a marble and tile floor and has a brass guard rail. The instruments are of the standard equipment. Provision has been made for the machines to be thrown on to the power bus-bars or lighting bus-bars, or both, as desired, and connection has been made so that the city mains may be used if required.

Mr. Alex. Storer,
Chief Engineer King Edward Hotel.

The building is heated by exhaust steam, the valves on the radiators being actuated by compressed air furnished by a small pump situated in the basement. A dial is placed on the wall of each room and the setting of the indicating finger to the temperature desired opens or closes the radiators, through the compressed air system, as the temperature falls below or rises above the desired point, as indicated by the dial. There is also a blowing engine for supplying compressed air for operating carpet sweepers. Throughout the building there are various stationary motors for operating fans, laundry machinery, etc.

The wiring has been executed in conduit, the different floors being provided with panel switchboards and all corridor lights being under lock switches—the latter a rather unique feature. Each room is provided with a telephone, with long distance connection to all parts of the country, there being the necessary switchboard and independent motor generator sets for this purpose.


Electric Plant at the Union Station, Toronto.

The elevators, three passenger and two freight, were installed by the Marine Engineering Company, of New York. They are operated electrically and have the usual solenoid control.

The entire power equipment, including engines, generators, switchboard and wiring, was contracted for by the Canadian General Electric Company, the Robb Engineering Company, of Amherst, N. S., and the Bennett & Wright Company, of Toronto, being subcontractors for the engines and wiring respectively.

Mr. Alex. Storer, the chief engineer, came from Scotland to this country when a small boy. He served his apprenticeship as machinist in the shops of the Toronto and Nipissing Railway at Uxbridge, Ont., and later gained considerable experience on the road. Subsequently he installed the plant at the Union Station, remaining in charge for seven years and resigning to accept his present position.

Mr. Geo. Storer,
Chief Engineer Union Station.

ELECTRIC PLANT AT THE UNION STATION.

A very neat electric and steam plant is to be found at the Union Station, Toronto. The engine and dynamo rooms are extremely well lighted from windows opening on a lane on the west side of the building. The floors are of concrete, and everything about the place is clean and cheerful. There are three Babcock & Wilcox boilers, one of 186 horse power and two of 93 horse power. Another of 186 h.p. is now being installed. These boilers are fitted with Murphy automatic stokers, and were the first furnaces installed in Canada in connection with which these stokers were employed. The fuel is fed into a hopper from which it descends into a magazine, and from thence is automatically fed into the fire. Cold air is admitted just above the coal, by which means the smoke is consumed. The power required for the automatic feeding device is supplied by a 1 horse power automatic engine attached to the end of the furnace.

Screenings are exclusively employed for fuel. This fuel is brought into a lane on the west side of the building and dumped through a coal hole into the proper place in the boiler room. It is then placed into a bucket of 1300 pounds capacity, which is carried by means of a compressed air hoist to a track above the boilers. The bucket is then moved along the track to the desired point and dumped. By means of this compressed air hoist the ashes which come from the furnace are also lifted in buckets through another coal hole into the lane, where they are dumped into carts. This compressed air hoisting apparatus is in use at many points on the line of the Grand Trunk Railway, and was manufactured at the company's works at Point St. Charles. The compressed air is pumped into a reservoir suspended from the ceiling.

Mr. W. Fuller,
Electrician Union Station.

Turning now to the steam and water apparatus, all returns come back from the south side station and the new station to a return tank, from which they are pumped again to the boiler. The pumps for this purpose were also made at the Grand Trunk Company's works at Point St. Charles. The quantity of water is regulated by an automatic governor which shuts off the steam at given points. On account of the distance to which the steam has to be forced to the south side station, the return water is cold when it gets to the pump, in consequence of which it is forced through exhaust heaters before going into the boilers. The elevators in the building are hydraulic, and after the water has done its work at the elevators it is pumped back again into the pressure tank by a Northey pump, 14 x 8½ x 12 inches, fitted with a Fisher governor. In order to get the right quantity of air into the pressure tank, the air is taken from the air reservoir above referred to. In case of accident to the pump, the city pressure can be employed to run both passenger and baggage elevators.

There are two Robb-Armstrong high speed engines of 80 horse power each, fitted with automatic oilers. The exhaust steam from these engines is used to heat the buildings. The steam pipe to each engine is 4 inches in diameter, and the exhaust pipe 5 inches. Should the engine get a dose of water, automatic valves are immediately released, by means of which the water is got rid of. The engineer in charge is Mr. George Storer, who is well qualified for the position he occupies. Mr. W. Fuller is electrician for the Union Station Company.

Coming now to the electric plant, about 2,000 lights have been installed, forty of which are arc lights. For the operation of these lights two Canadian General Electric Company generators are employed. Both arc and incandescent lights are run off the same generator. By means of a triple pole switch the current can be obtained from the Incandescent Light Company, in case of accident to the generators or when repairs have to be made. The building is wired for both the two and three wire systems.

The switchboard consists of green slate panels, on which are mounted two Weston volt meters, two ammeters, sixteen 3 pole switches, two 2 wire dynamo switches, one break-down switch and two pilot lamps.

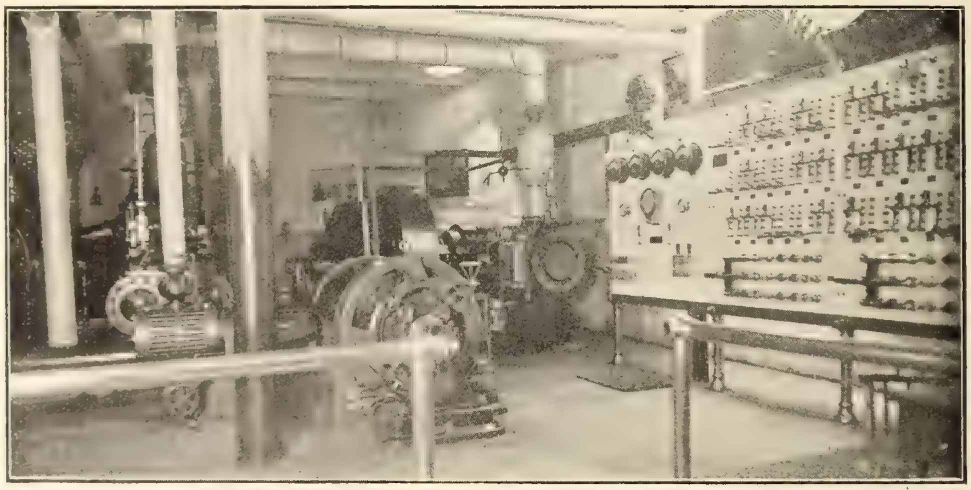
The generating plant, in addition to lighting the buildings, furnishes current for the electric signal system installed by the company a few years ago. The switches and semaphores are lighted by incandescent lamps placed inside of discs carrying colored glasses, which revolve around the stationary lamp and display the different signals.

ELECTRIC PLANT AT THE CITY HALL.

An interesting isolated plant, recently installed, is that at the City Hall, Toronto. There are two boiler rooms, the one located to the east of the engine room containing four Heine water tube boilers, one of a capacity of 250 h. p. and three of 150 h. p. Three are equipped with the Holly down draft furnace and one with the straight bar. The boiler room on the west contains four tubular boilers, 60x14, manufactured by the Polson Company, of Toronto. Three of these are equipped with the Jones underfeed stoker and one with the straight bar. The Heine boilers are controlled by the Johnson damper control and the tubular boilers by the McDonough damper regulator, which controls the speed of the engine on the fan system.

Coal is delivered by means of trucks direct from the coal bin, which has a capacity of 150 tons, each fireman keeping an accurate account of the amount of coal burned during his run. The ashes are removed by means of cars and an elevator provided for the purpose.

The feed pumps are three in number, of Northey make, and are controlled by a pump governor. Each pump is sufficiently large to handle by itself the entire plant.



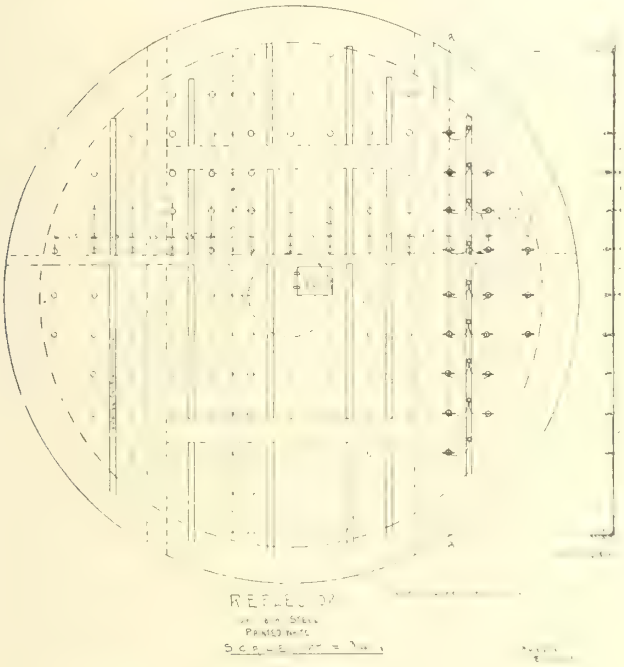
City Hall, Toronto—General View of Electric Plant.

The generating room has a concrete foundation. The unit shown in the foreground in the illustration comprises a 9x10 McEwen engine, of Waterous manufacture, direct connected to a United Electric Company 25 k. w. dynamo. The other unit consists of a 16x17 Robb-Armstrong engine direct connected to a Canadian General Electric 100 k. w. machine. During the day time the load, which is not over 100 amperes, is carried by the small unit, while the larger machine is operated to take the heavier load at night and the small unit is shut down. In this way the plant is operated very economically.

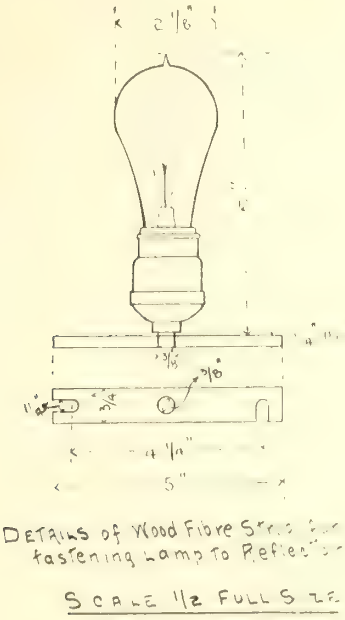
The switchboard, 6x20 feet, of marble, also installed by the Canadian General Electric Company, contains the usual equipment of ammeters, switches, etc. The board was mounted by the Crouse-Hinds Company, of Syracuse. Each machine is supplied with an improved circuit-breaker. All circuits are handled by individual switches on the board, in charge of the engineer. A 1,200 ampere Thomson recording watt-meter gives the proper reading and watts output.

Two motors of 1½ h.p. each are located in the attic, and are intended for taking ventilation from the lavatories.

The wiring throughout the building is of the two-wire system, equipped with junction boxes at intermediate points to properly handle the current. There are connected up 3,300 16 c. p. incandescent lamps, in addition to the tower clock lighting, the wiring having been executed by the Bennett & Wright Company.



PROPOSED PLAN OF LIGHTING TOWER CLOCK OF CITY HALL, TORONTO.



Mr. James Bannon, the chief engineer, is now installing the tower clock lighting. As the result of considerable experiment, he has devised a system which he believes will give splendid satisfaction. The plan proposed is shown by the accompanying illustrations. He proposes to use 480 8 c. p. incandescent lamps, 120 on each dial, placed 17 inches apart, and fitted up with 22 gauge galvanized iron reflectors properly stayed and braced to the present wind braces. The lamps will be 20 inches distant from the dial and each individual lamp will be handled separately and seen from the inside, so that they can be replaced in a moment's notice in case of accident to any of the circuits. The holes in the reflectors through which the lamps are inserted are 2¼ inches in diameter and will permit sufficient daylight to light the present room, also the necessary circulation of air inside the reflector when the lamps are lighted. The lamps are perfectly insulated by means of a wood fibre strip, as shown in the drawing. The mains of the clock lighting are open wiring to the base of the tower, then conduit until the tower shaft is entered, then open wiring again to the dials. In the installation enough copper has been provided to meet the requirements for outside illumination at any time, it being possible to tap the line at any point for this purpose.

The dials of the clock are 20 feet 6 inches in diameter and a height of 265 feet from the sidewalk. The usual custom is to light clocks of this size by means of arc lamps or 16 c. p. incandescent lamps. Mr. Bannon found, however, that in most cases the individual lamps could be discerned from the outside, to obviate which he decided to make use of lamps of eight candle power, by means of which, he claims, a more even distribution of light and more satisfactory results will be obtained. By a proposed treatment of the glass in the dials, it is expected that the lamps will not be discernible from the outside, as is usually the case. It is estimated that 100 amperes will be required to light the clock, which was installed by Gillett & Johnston, of Croydon, Eng., and is now running very accurately, the variation not exceeding two seconds per month.

MR. JAMES BANNON,
Chief Engineer City Hall, Toronto.

The chief engineer has also under his charge fifty pneumatic clocks throughout the building, controlled direct from the engine room and furnished by the Johnson Electric Service Company, of Milwaukee.

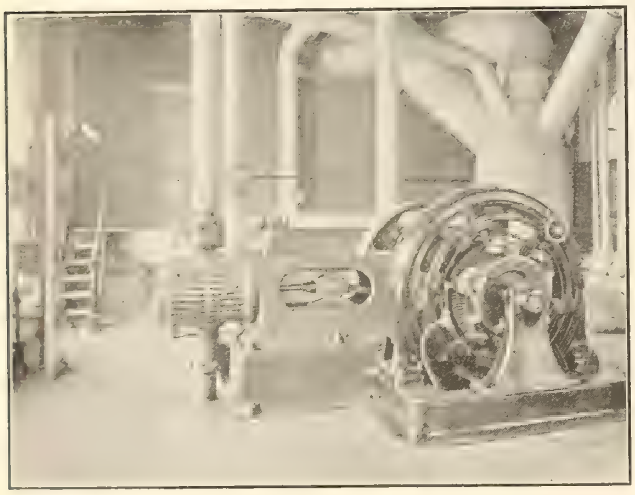
The steam heating of the building is accomplished by means of the one-pipe system, all exhaust steam being utilized for that purpose during the winter months. The temperature of all rooms is controlled automatically by thermostats installed by the Johnson Heat Control Company. A complete circulation throughout the building, with one atmosphere, is obtained with the Paul system attached to the heating system, and the whole being controlled by the switchboard in the engine room. A system of ventilation is furnished by four Sturtevant engines, 8x10, located in the basement and direct-connected to Sturtevant fans, which take air from the extreme top of the tower and force it to all rooms in the building. The ventilation is also controlled by the Johnson heat control device, the temperature during the winter months being set at about 68 degrees Fah. The air is heated by steam coils using live steam at ½ pound pressure. The capacity of the fans is equivilant to changing the air in the entire building once in eight minutes. The exhaust from each room enters large stacks, one located on each side of the building, and is carried outside.

The elevators, three in number, were installed by Leitch & Turnbull, of Hamilton. There is one on each side of the building and one in the tower. The elevator pumps were made by the East Buffalo Pump Company and are of the size 12x18x10x12. Any one of them will handle the elevators during the day ; at night the pumps are shut down and the elevators worked entirely on city water pressure of 80 pounds. During the day the compression tanks carry 120 pounds pressure. During the tourist season the tower car is worked continuously, it being open to the public from May 1 to November 15.

Mr. James Bannon, chief engineer, has been associated with the plant since 1900, having had entire charge since March, 1892. This position he secured through a competitive examination, and the efficient manner in which the plant has since been operated shows that he is well qualified to discharge his duties. He was formerly employed as engineer at the Island Waterworks, and later at the Parliament Buildings under Mr. A. M. Wickens.

ELECTRIC PLANTS IN TORONTO.

An illustration is shown herewith of the electric plant at the City Dairy, Spadina Crescent, an institution well worthy of a visit. A C. G. E. 125 volt direct current generator is connected to a McEwen engine, the current being used for both lighting and power. The switchboard is of standard equipment. There is also a Wheelock engine for driving the refrigerating plant.



Electric Plant at City Dairy, Toronto.

About two years ago the Lever Bros. Company installed at their soap works in the east end of the city a plant for power and lighting. There are two Heine boilers and a Robb-Armstrong engine. The generator is a 200 volt 125 k.w. machine operating at 240 r.p.m. and manufactured by the United Electric Company, of Toronto. The generator supplies current for a dozen motors throughout the works, as well as for arc and incandescent lamps. The switchboard is of pink Tennessee marble and is fitted with Weston instruments and the usual automatic circuit breakers, switches, etc. The generator, motors, switchboard and arc lamps were all manufactured by the United Electric Company.

Electricity is employed for both power and lighting at the works of the Gutta Percha & Rubber Company in Parkdale. Two 50 k.w. 125 volt C.G.E. generators are direct connected to "Ideal" engines manufactured by the Goldie & McCulloch Company, of Galt.

An isolated plant of considerable size is that in the Temple Building, corner of Bay and Richmond streets. The steam plant consists of two Heine boilers of 180 h.p. each fitted with Jones underfeed stokers. Three direct current 50 k.w. Walker generators, installed by the United Electric Company, are direct connected to "Ideal" engines. One generator is wound for 250 volts and is running at 275 r.p.m., supplying current for motors and electric elevators. The other two generators are wound for 125 volts and furnish the current for lighting. A motor generator of 80 lights capacity supplies lighting during the day-time. The switchboard and wiring were contracted for by the Bennett & Wright Company.

One of the first electric plants to be installed in the city is that of the Incandescent Light Company on Teraulay street. There are six return flue boilers of 175 h.p. each and two Babcock & Wilcox water tube boilers of 400 h.p. each. The engines are six in number, two straight lines, three Armington & Sims, and one Lake Erie cross compound. The generators are of the Edison type, manufactured by the Canadian General Electric Company at Peterboro.

Electric plants are also in operation at the Parliament Buildings, Mercer Reformatory, the Asylum, and several other buildings, but lack of space prevents further reference.

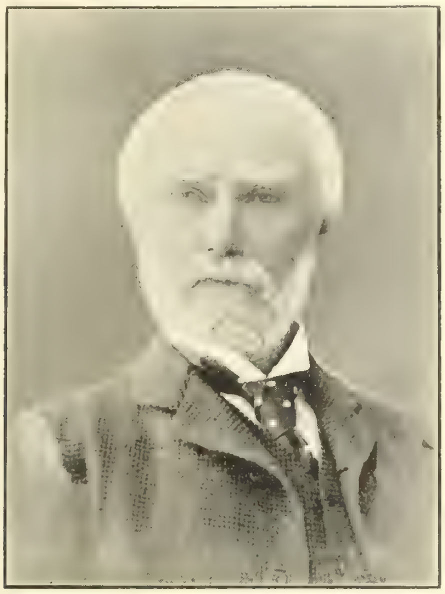
MOONLIGHT SCHEDULE FOR JULY.

Date.	Light.	Date.	Extinguish.	No. of Hours.
July 1	10 30	July 2	3 30	5 00
2	11 00	3	3 30	4 30
3	11 30	4	3 30	4 00
5	0 15	5	3 30	3 15
6	1 00	6	3 30	2 30
7	1 40	7	3 40	2 00
8	No Light	8	No Light	.....
9	"	9	"	......
10	"	10	"	.....
11	8 10	11	10 10	2 00
12	8 10	12	10 30	2 20
13	8 10	13	11 00	2 50
14	8 10	14	11 30	3 20
15	8 10	16	0 00	3 50
16	8 00	17	0 30	4 30
17	8 00	18	1 10	5 10
18	8 00	19	1 45	5 45
19	8 00	20	2 30	6 30
20	8 00	21	3 15	7 15
21	8 00	22	4 00	8 00
22	8 00	23	4 00	8 00
23	8 00	24	4 00	8 00
24	8 00	25	4 00	8 00
25	8 00	26	4 00	8 00
26	8 00	27	4 00	8 00
27	7 50	28	4 00	8 10
28	7 50	29	4 00	8 10
29	7 50	30	4 00	8 10
30	7 50	31	4 00	8 10
31	10 00	Aug. 1	4 00	6 00
		Total............		151 25

The Galt, Preston & Hespeler Electric Railway Company have recently added to their rolling stock a new passenger car, 51 feet long and equipped with all modern accessories. Electric buttons are placed on the sides at each seat so that passengers can ring when wishing to alight. It is lighted with 32 incandescent lamps.

THE G. N. W. TELEGRAPH COMPANY.

As no doubt most of our readers are aware, the general offices of the Great North-Western Telegraph Company are located at Toronto. The building which the company occupies on the corner of Wellington and Scott streets was built by the Montreal Telegraph Company, for its own use, under the supervision of President and General Manager Dwight, about thirty years ago, and was taken over by the Great North-Western Telegraph Company at the time the Montreal and Dominion Telegraph Companies were merged in the Great North-Western in 1881. When the building was first erected it was justly considered a very handsome edifice, and it certainly was one of the most commodious and best-planned telegraphic offices of its day. The whirligig of time works wondrous changes, however, and where, under the old order of things, there was plenty of room and to spare, the company now finds itself, with its largely increased business, somewhat cramped for space, and several rooms in the adjoining building have been secured to accommodate a portion of the staff.



Mr. H. P. Dwight,
General Manager G. N. W. Telegraph Company.

The telegraph business, in keeping with the general business of the country, has increased by leaps and bounds during the past few years, and the Great North-Western, besides strengthening and improving its plant in all directions, has from time to time, to meet the increased traffic, added a number of new wires to the most important routes. This work, of course, has been in charge of the enterprising and able superintendent of construction, Mr. A. B. Smith, who, always a busy man, is in his element when immersed in work in which a bold push is required to complete a certain job in a specified time. Quite recently a copper wire of the most approved gauge was erected between Buffalo and Montreal. This wire is worked quadruplex. It need scarcely be explained that this allows of transmitting messages two ways in opposite directions over a single wire, thereby enhancing the usefulness of the wire fourfold. Six quadruplexes are in constant use in the Toronto office of the Great North-Western.

A very interesting feature of this company's operations here is the Ticker Service. The aerial galvanized wires over which the New York and Local Stock Ticker circuits and the Sporting Ticker circuit were formerly worked have been removed, and copper wires substituted, greatly improving the efficiency of these circuits. The demand upon the resources of the G. N. W. by brokers and financial agents for leased wires has received a decided impetus lately. The Great North-Western has an exclusive connection with the Western Union Telegraph Company, and President Dwight returned only the other day from New York, where he had been in consultation with Col. Clowry, President and General Manager of the Western Union, in regard to matters of interest to their respective companies. While Mr. Dwight was in New York arrangements were made for the erection of additional wires during the coming season to meet the increased demands of international business.

The Great North-Western has just finished re-wiring its Toronto operating room—putting in a new Bunnell switch, capable of accommodating 100 lines, and introducing other new telegraphic apparatus. The switch is a very elaborate affair, and quite an ornament to the office. The latest pattern of loop switch has also been added to the office equipment. These two switches allow of any possible combination of wires likely to be called for in a telegraph office. All the old wiring under the operating room floor has been removed, and cables have been laid in metallic troughs carrying a new set of wires, with carefully soldered joints, to every instrument in the office. The operating tables, which are also new, are what is known as the sextette pattern, seating six operators, three on each side of the table. The work of making these changes has been in progress, by easy stages, for the past six months, the change, which was under the immediate direction of Inspector W. J. Duckworth, having been effected without causing a moment's interruption to any of the wires in the building. It may be confidently asserted that the operating room of the G. N. W. at Toronto is now in every respect one of the best organized and equipped, and as thoroughly modern in all its appointments, as any similar room on this continent. All the lines in the office are worked from dynamotors, the power for running these machines being supplied by the Toronto Electric Light Company.

Mr. A. B. Smith,
Superintendent of Construction G. N. W. Telegraph Company, and
Acting Chairman of the Local Committee C. E. A.

As Toronto is the headquarters of the company, and the Audit Department, Treasury Department, Stores Department, Construction and Maintenance Department, and Press Department are all stationed here, the entire force, including the operating staff, employed in this city by the G.N.W. is necessarily a very large one.

The Great North-Wertern Telegraph system now embraces 18,000 miles of poles and 42,000 miles of wire, with some 1,800 offices distributed throughout Ontario, Quebec, New Brunswick, Manitoba and a section of British Columbia.

C. P. R. TELEGRAPHS.

The C. P. R. Telegraphs is, as is generally known, a department of the Canadian Pacific Railway. The head office is in Montreal, Mr. James Kent being the general manager. The telegraphic business of the railway was established in 1886, since which time its growth has been very rapid. The Toronto office, naturally one of the most important, is situated in the Board of Trade building at the corner of Front and Yonge streets. Mr. A. W. Barber is superintendent of the Ontario division, and Mr. D. G. Sturrock local manager at Toronto. When the business was established seventeen years ago, it was handled by twelve wires and a staff of six operators, twelve messengers and four clerks. To-day thirty-six wires are required to handle the business, while the number of operators has been increased to thirty-five, the messengers to fifty, and the clerks to fourteen. As an indication of more recent development in the company's businesss, it may be stated that within ten years the traffic of the Toronto office has fully doubled.

The general offices and receiving room are located on the first floor of the Board of Trade building, and the operating department on the seventh floor. Messages are conveyed from the receiving offices to the operating room and vice versa by a pneumatic tube system operated by a "Roots" blower driven during the day by an engine in the building and when required at night by an electric motor. The operating room proper contains switch-board capacity for seventy wires and accommodation for seventy sets of instruments—eight quadruplex instruments being in use. Current for the wires and instruments is furnished by motor generators situated in a separate room. They are twelve in number, of the Lundell type, and were manufactured by the Sprague Electric Company, of New York. Connection is made by means of twelve 5-conductor cables (one cable to each machine) with the switchboard, which is bolted to a framework of angle iron secured to the floor and ceiling. On each side of the switchboard are the rheostats, one for each machine, while above are the ammeter and voltmeter, of Weston make. The current is obtained from the Toronto Electric Light Company, but there is also an emergency switch for connection with the electric plant at the Union Station in case the current from the Toronto Electric Light Company should fail. The generators are wound for 225 volts, the secondary rating being as follows: One of 110 volts, two of 30 volts, three of 130 volts, three of 225 volts, and three of 400 volts.

The generating plant was installed about three years ago, and replaced some 2,000 cells of battery required to operate the instruments and wires at that time. In the meantime additional quadruplexes have been added which would have necessitated increasing the number of battery cells by about 1,000. The entire load is now taken care of with ease by the dynamo plant, which has also effected a large economy in space, occupying as it does only about one quarter that which had been taken up by battery jars.

The operating room now handles an average of 4,500 messages per day, in addition to from 60,000 to 70,000 words of press matter. This department is in charge of Mr. F. C. Robertson, circuit manager for the Ontario division. Mr. Robertson has acted in this capacity since the inception of the C. P. R. Telegraphs, previous to which time he was associated with the Dominion Telegraph Company, and later with the Mutual Union Telegraph Company and Postal Telegraph Company of the United States.

The city branch offices are forty in number, located in all sections of the city. A staff of line-men is kept constantly on duty for repair work, under the direction of Mr. E. A. Speer, foreman.

THE BELL TELEPHONE COMPANY IN TORONTO.

The Bell Telephone Company's system in Toronto is operated by means of three central offices, viz., the "Main," "North" and "Parkdale" exchanges.

The "Main" is situated on Temperance street, near Bay, in a three storey, fire-proof, brick building, which also contains the Toronto manager's and other local offices. The telephone lines enter the building underground in cables of from 50 to 400 pairs of wires each, which terminate in an iron distributing frame ; all lines are protected from high potential or other dangerous currents by the usual combination of an air gap, sneak current and fuse protector. The distributing frame is situated on the ground floor, while the operating room and switchboard are on the second, connection between them being made by means of fine wire switchboard cables.

The switchboard is of the branch-terminal, self-restoring drop type arranged for about sixty subscribers' positions of eighty lines each, ten in-trunk positions, and twelve long distance positions, besides desks and tables for the chief operator, assistants, monitors, etc. This exchange has now about forty-five hundred subscribers' lines working in it, and has about reached its limit.

To take care of future development, land was secured immediately to the east of the old building in 1902 and an addition of about the same size as the original building erected, which addition is just nearing completion.

Here will be placed this year a switchboard of the most modern, common battery type, having capacity for eighty-eight hundred subscribers' lines. When this work is completed, all the Toronto offices will be run on the common battery system, the latest and most efficient scheme for central office operation yet devised.

The long distance system of the company centres in this office. Here terminate all the lines from outside of Toronto by means of which communication can be had with points in Canada as far distant as the shores of Lake Huron and Windsor on the west; Montreal, Ottawa, Quebec and the eastern townships in the east; as well as United States points, such as Chicago, St. Louis, Pittsburg, New York and Boston, with all intermediate stations.

The "North" office, located on Hayden street, near Yonge, is a two-storey, slow-burning construction, brick building erected in 1901. The lines enter the building in the usual manner by means of underground cables which terminate in protectors on the main distributing frame, switchboard frames connecting it to the intermediate frame and switchboard proper.

The switch is of the common battery or relay type, and differs materially from the "Main" switch. Miniature incandescent lamps, controlled by relays, take the place of the self-restoring annunciators and give great satisfaction, as they are easily seen, take up but little room and may be placed immediately above the jack with which they are associated, by so doing facilitating the operator's work considerably.

To signal the Central office, a subscriber merely removes the telephone from its supporting hook, when a lamp connected with his line at the Central office lights, drawing attention to that line; on the operator inserting the plug of one of a pair of connecting cords in the jack of the calling line, the lamp is extinguished. The operator after inquiring for the number wanted, completes the connection with the second cord. Associated with these cords are supervisory lamp signals, also controlled by the switch hook at the subscriber's station. If the cord is connected to a line and the telephone of that line is on the switch-hook, the lamp associated with the cord lights up, if the telephone is off the hook the lamp remains dark, consequently the operator has a positive signal in front of her as to the condition of the line, being able to tell at a glance whether a subscriber has answered a call, and whether a conversation is finished and the lines should be disconnected, or whether an error has been made and the subscriber requires further recognition. By means of these signals, a great deal of work is taken from the ear and given to the eye of the operator, a condition which telephone engineers are always striving to bring about, on account of the greater quantity and more efficient work which can be done by an operator.

This switchboard has a capacity for forty-two hundred lines, and has now about twenty-seven hundred lines working on it. There are also eight in-trunk positions to receive calls from other offices, and room for the extension of both these and the regular subscribers' positions.

Power to light the lamps, give current to the operators' instruments, and above all to those of the subscribers (for by this system local batteries are not needed) is derived from a series of eleven cells of storage battery of about 1000 ampere hours capacity. This battery is charged from one of two motor-generators, run from the mains of the Toronto Electric Light Company.

The "Parkdale" office is on Cowan avenue, near Queen street, and consists of one storey and a basement. The building is of brick and built on the slow-burning plan. The switchboard is similar to that of the "North" office, except that its capacity is for thirty-five hundred subscribers' lines, there now being about twelve hundred lines working in the office, which is being enlarged to take in an addition to the switchboard.

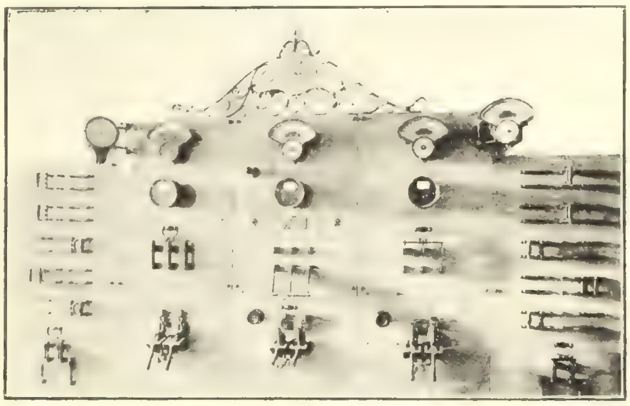
When this work and the new "Main" office installation is completed, Toronto will be one of the best equipped telephone exchanges in America, if not in the world.

BOARD OF TRADE SWITCHBOARD.

Herewith is shown an illustration of the switchboard manufactured by the Hill Electric Switch Company, Limited, of Montreal, for the Board of Trade Building in that city. This board was designed and constructed entirely by the above company, the consulting engineer giving them a free hand to produce an artistic, as well as a thoroughly mechanical and electrical job, the result being a board that has pleased both the consulting engineer of the Board of Trade, Mr. R. P. Southard, and the resident engineer, Mr. A. York.

The board is designed to handle the output of three multi-polar C. G. E. generators of 500 amperes, 110 volts, to run separately or in multiple. Provision is also made for current from the local lighting company, and all distributing switches are double throw, thus enabling current to be used from either sources at the same time, while a special single throw switch is connected to the D. C. bus-bars only, which controls a motor for freight elevator.

As will be seen, there are three generator panels, of blue Vermont marble, three feet wide, seven feet long and two inches thick, each fitted with I.T.E. circuit breakers, three pole 600 ampere switches of the well-known Hill type B, above which are recording watt-meters of the well known Scheeffer switch-board type, supplied by the Packard Electric Company, and above these again are illuminated dial, type K, Keystone ammeters.



Switchboard in Board of Trade Building, Montreal.

Each panel is fitted with a rheostat for field control, while the centre panel has a ground detector switch and lamp as well as a volt-meter switch which enables readings to be taken from any of the three generators as well as the A. C. bus-bars. Two swinging brackets are fitted to these panels, one holding a Keystone type K volt-meter, the other a Bristol recording volt-meter.

The center pole of the switches is fitted to an equalizer bar, the three switches being connected to the inner bus-bars, which are carried down to the inner terminals of the double-throw switches on the two distributing panels on either side of the generator panels. These double-throw switches are also of the Hill type B pattern, fitted with D. W. enclosed fuses.

Alternating current is taken in on an 800 ampere switch at bottom of distributing panel No. 1, carried up heavy bus-bars and across the board down the outside of No. 2, so that when switches are thrown out they connect with outside supply and when thrown in they connect with the generator supply.

A large wrought iron grille, with clock, crowns and whole, making a pleasing effect and showing the board off to good advantage.

QUESTIONS AND ANSWERS

"Reader" : One of the bearings on our dynamo leaks oil badly ; what is the best way to stop it ? What is the object of painting the insides of bearings the way some of them are done ?

Ans.—If the leak is through the joint of a split bearing hang something over the joint, such as a piece of sheet tin, soldered to the upper half, or chamfering the edges of the bearing will usually remedy the difficulty. If the oil is travelling along the shaft, it is found that a groove on the inside of the sleeve, about ¼ to ½ an inch wide, and about the same depth and distance from the end, together with one or two ⅜ to ⅝ drainage holes at the bottom of the groove, right through the bearing, are very satisfactory. Perhaps the shaft may be found with its shoulder rubbing tight against the bearing. This is occasionally the cause of oil throwing; the remedy is obvious, give the shaft some end play. The painting the inside of the bearings keeps sand and scale from loosening under the action of the oil and thus getting into it and the bearing, with the consequent liability to cutting and heating. It also tends to prevent the oil leaking through any small cracks or fissures which may originally exist in the casting.

"Superintendent" : I have a direct current arc machine which is at present operating open arc lamps. Can I run enclosed lamps from it ? If this is possible will it reduce the capacity ? Can I run both open and enclosed from it at the same time ?

Ans.—There is no difficulty in operating enclosed lamps from a machine built originally for those of the open type provided the amperage is not greater than about 6¾ amperes. Direct current enclosed lamps are not built for larger currents than this. The capacity in kilowatt or horse power output will remain the same, but as each enclosed lamp takes about 80 volts, as against 50 volts for the other type, the number of lamps you can operate is reduced in that proportion. You can run both open and enclosed lamps from the same dynamo, the amperage of both of course being the same, or if your open lamps are higher than 6¾ amperes, you can put a shunt round the enclosed lamps to take the extra current, though this is not a very efficient method.

" Mill Owner"—Which is the most preferable type of water wheel, the vertical with gears and pinions, or the horizontal direct coupled to the generator ?

Ans.—It is impossible to say that one type or the other is better suited to any particular case without having full details regarding it. The first cost of the direct coupled type is usually greater than that of the other ; the design does not lend itself so readily to the highest efficiency, and the range of speeds is limited in that those of the wheels and the generator must be the same. On the other hand, the absence of gears reduces the attendance required and the cost of repairs, besides eliminating the losses in the friction of the gears and the noise they make. There is also less likelihood of trouble from end thrust on the shaft. On the whole it is generally considered that the direct-coupled type is the more mechanical and neater unit, especially for the larger plants and those where reliability and continuity of service are of prime consideration.

" Railway Man " : Is a street car controller built for say two 50 h.p. motors satisfactory for use with four motors of 25 h.p. each ; (B) and is the reverse true ?

Ans.—You cannot use a 2 motor controller to handle four machines because it is equipped with only two reversing switches, which means that the two motors forming one of the groups must have their fields connected permanently in parallel, and also their armatures. This will give you extremely unequal division of load between the two motors so cennected, and prevent satisfactory operation. (B) You cannot run two 50 horse power machines from a four 25 horse power controller because, though the total capacity is the same, certain of the wiring, contact fingers, etc., would have to carry just twice the amperage they were designed for, and would probably get too hot, besides giving trouble from severe arcing and cutting.

"Dynamo" : Can I use one wattmeter in measuring the power on both three phase and two phase circuits ?

Ans.—If the load is the same on all the phases, and has the same power factor, one wattmeter will give correct measurements, the reading being multiplied by $\sqrt{3}$ or 1.733, in three phase systems, and by 2 in the other case. In addition to both these constants you would also have to use the dial constant. We presume you understand that there are meters made which are virtually two instruments in one case and which are specially for use on polyphase circuits, giving correct totals on one dial, irrespective of any unbalancing in the various legs.

"J. R. Y." : Does a direct current motor run faster or slower when it is hot than when it is cold, and why? What about an alternating motor ?

Ans.—A direct current shunt wound motor runs faster when hot, due to the fact that the field resistance rises with the temperature and consequently the field current, and with it the field strength, falls. Series wound motors tend to run slower as they get hotter because of the increase in the resistance of both armature and fields. Alternating induction motors also act in the same manner, alternating synchronous motors keep a constant speed, or rather keep in step with the generator driving them, irrespective of their temperature.

" Engineer" : I have an engine which occasionally gets a very hot bearing, and which cannot be shut down to cool it off. Can you give me any means of stopping it ?

Ans.—We presume you mean some way of running the bearing without injury until it can be shut down and the seat of the trouble located, in which event we would say that if copious oiling, the application of lubricants like graphite, loosening the boxes, etc., will not stop the heat increasing, you might try a cold water hose running into the bearing, or ice on the box. Sometimes good results can be obtained by a small endless belt round the shaft close to the box, the lower end dipping into cold water. This last method has an advantage in that it makes less mess than some of the others.

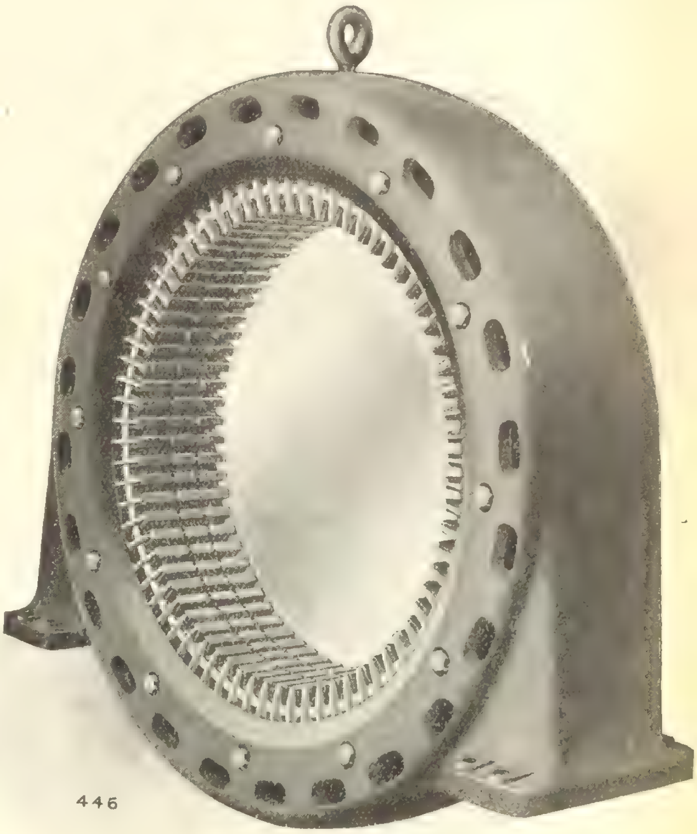
"CECO" ELECTRICAL MACHINERY.

The Christensen Engineering Company, Milwaukee, has recently placed upon the market new lines of "Ceco" electrical machinery, including direct current motors and generators, alternators and transformers.

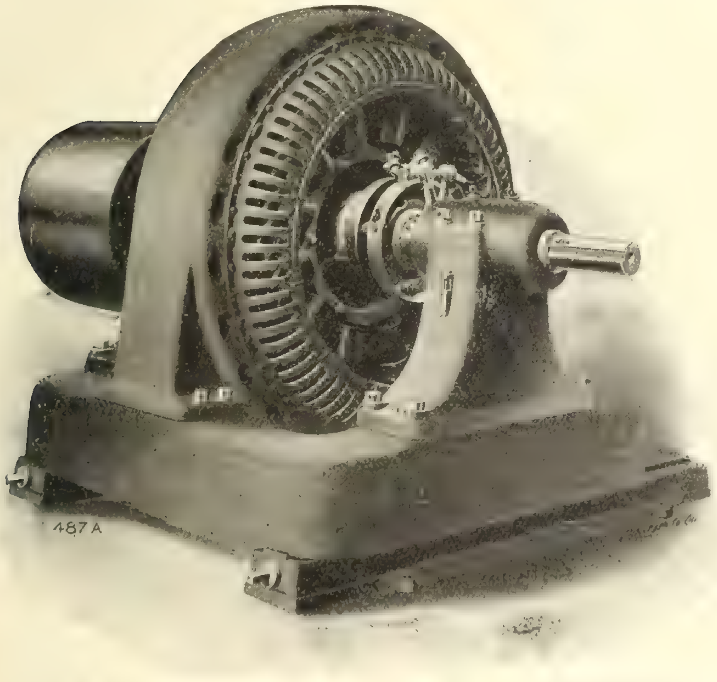
For several years this company has been manufacturing electric motors for driving air-compressors used in connection with the well known Christensen air-brake equipments on electric cars. More than 8000 of these motors are in highly satisfactory service throughout the world. The company has also built a large number of motors of various capacities for driving air-compressors used in general commercial service, and all the motors for driving machine tools and shafting in their own works. In order to manufacture this electrical apparatus, the company has maintained an extensive equipment, particularly suited to the purpose. Some time ago it was decided to greatly increase the company's manufacturing facilities, and to develop a complete line of electrical machinery of the highest grade.

The policy of the Christensen Engineering Company has always been not to place any apparatus on the market until the entire work of development had been satisfactorily completed. The exceedingly high reputation and remarkable success of the air-brake apparatus are highly due to this policy. Therefore the company has made no announcement regarding its electrical apparatus until the various lines were completely developed and severely tested. The results proved that these machines are in design, construction and performance worthy of the high reputation now accorded to the Christensen air brake equipments.

The company is now building machines for general power, railway or lighting purposes. The line of "Ceco" alternators, (Cut No.487 A) ranging in capacity from 37½ to 1500 K.W., is illustrated herewith. All the "Ceco" alternators, whether belted, engine type or direct coupled, are of the revolving field type, thus leaving the armature stationary and easily accessible. By this form of construction the difficulties of properly insulating the armature coils, which have caused much trouble in rotating armatures, are eliminated.


446

Armature Frame for Engine Type "Ceco" Alternator.

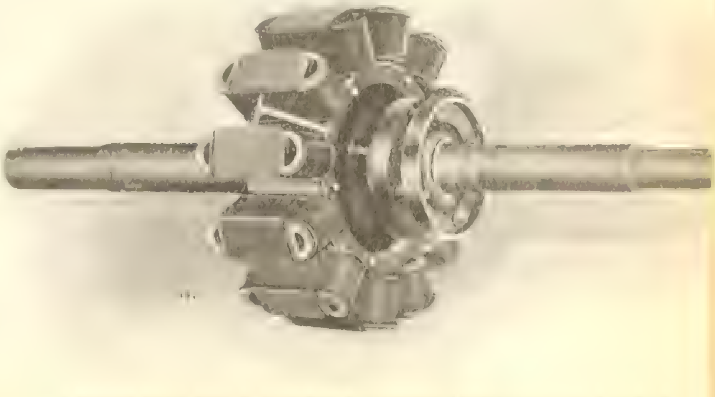

487A

250 K.W., Belt Driven, Three-Phase "Ceco" Alternator.

The frame (Cut No. 446) consists of cast-iron housings, into which rings of laminated steel with inwardly projecting teeth are assembled, thereby forming slots for receiving the armature windings. The armature is designed with six slots per pole, so that it may be wound or rewound for single, two or three phase, as required. The armature frames for the belt driven alternators are cast in one piece, while the frames for the direct driven machines are divided horizontally. Instead of the usual practice of having several coils for the same machine, all the armature coils for each "Ceco" alternator are of the same size and shape so that they are interchangeable. The coils are specially insulated, so that they will stand without injury the highest temperature that will ever be reached in service. The ventilation of the armature is exceptionally good, ventilating ducts being provided at intervals in the core, assuring a good radiation of the heat generated. This is of great importance for preserving the insulation in the case of high tension machines.

The poles, (Cut No. 476), are built of laminated steel upon a cast iron spider, which is mounted upon a forged steel shaft. In the large sizes, the laminated poles are assembled upon a steel ring which is carried on the shaft by means of the cast iron spider. The individual poles are in all cases easily removable with their coils, without dismantling the machine. The field coils are composed of rectangular copper straps bent on edge. The collector rings are made of cast iron, and carbon brushes are used, thus reducing to a minimum the tension required, as well as the wear of the parts. Standard frequencies are 60 and 25 cycles per second. With the exception of the smaller sizes, "Ceco" alternators can be wound for any voltage up to 15000. The temperature rise, when running continuously with full load at any power factor, will not exceed 35° C. in the armature or 40° C. in the fields. At 25 per cent. current overload the corresponding temperatures will not exceed 40° C. and 50° C. The machines are all designed so that they will carry satisfactorily a 50 per cent. current overload for two hours at any power factor without injurious heating.

The company's works are extensive, and no expense was spared in providing every facility for the rapid, accurate and economical manufacture of their product. The equipment of machine tools, cranes, special machines, etc., is unusually modern and complete.



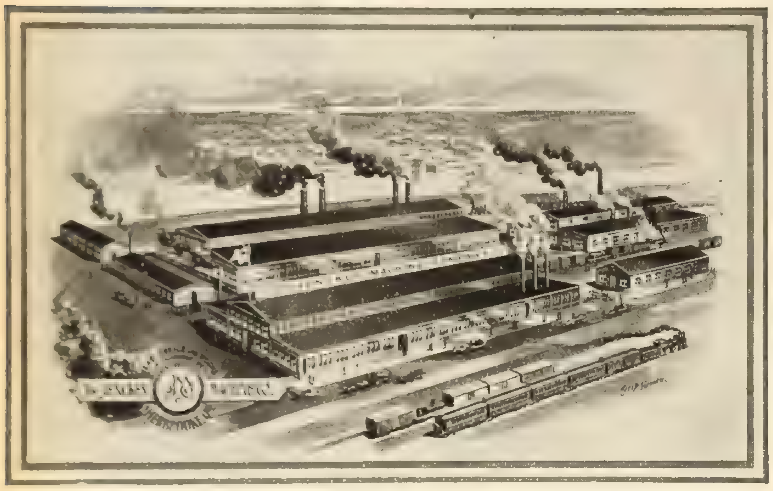
Revolving Field for Belt Driven "Ceco" Alternator.

A VISIT TO THE JENCKES PLANT.

[By Our Travelling Representative.]

The visitor to Sherbrooke, as he steps off the train at the Union Station, can scarcely fail to notice the long brick buildings of the Jenckes Machine Company, which cast shadows over the St. Francis river, but a minute's walk from the station.

Passing through Sherbrooke as I did, merely making a flying visit, I had not the time to spend that I would have liked, but I found sufficient to make a short visit to the shops of the Jenckes Machine Company, a company with the name of which, at least, most of the readers of the Canadian Electrical News are familiar.



The Jenckes Machine Company—Works at Sherbrooke, Que.

Entering the main office the hum of machinery became audible, and through a window in the partition I could see a portion of the vast machine shop interior, with the huge travelling crane in the distance.

One of the members of the office staff acted as cicerone for me, and together we entered the turbine department of the works. A number of turbines were in different stages of completion, some in cast iron, some in steel, and some in bronze, and my guide pointed to the far end of the shop, where four wheels of large size were being loaded on a car by the travelling crane. These, I was informed, were for the pulp mill of Mr. J. R. Booth at Ottawa, as were also 28 more of similar size. They were to develop some 9000 h.p., under a head of about twenty feet, and men were working on them night and day to get them completed.

An installation of wheels for a similar amount of power has recently been made by this company for the pulp mill of the Brompton Pulp and Paper Company, at Brompton Falls, Que., on the St. Francis river, some eight miles below Sherbrooke.

Two small wheels, 15 inches in diameter, caught my eye, and on enquiry I found that they were a special pattern, being built for the Dominion Bridge Company. Each wheel was of bronze, running in a steel case, and was of about half the capacity of the standard runner, developing 100 h.p. under a head of fifty feet, instead of 180 h.p. of the regular runner.

Orders are now under way, or nearing completion, for seventy-five Crocker turbines, and difficulty is found in getting work on them out fast enough to meet the demands.

The engine department, where the Jenckes-Corliss engines come from, was not as heavily pressed with work as the turbine section, although work was being pushed on a large Corliss hoisting engine for the Dominion Iron & Steel Company at Sydney, and a couple of other engines were on order.

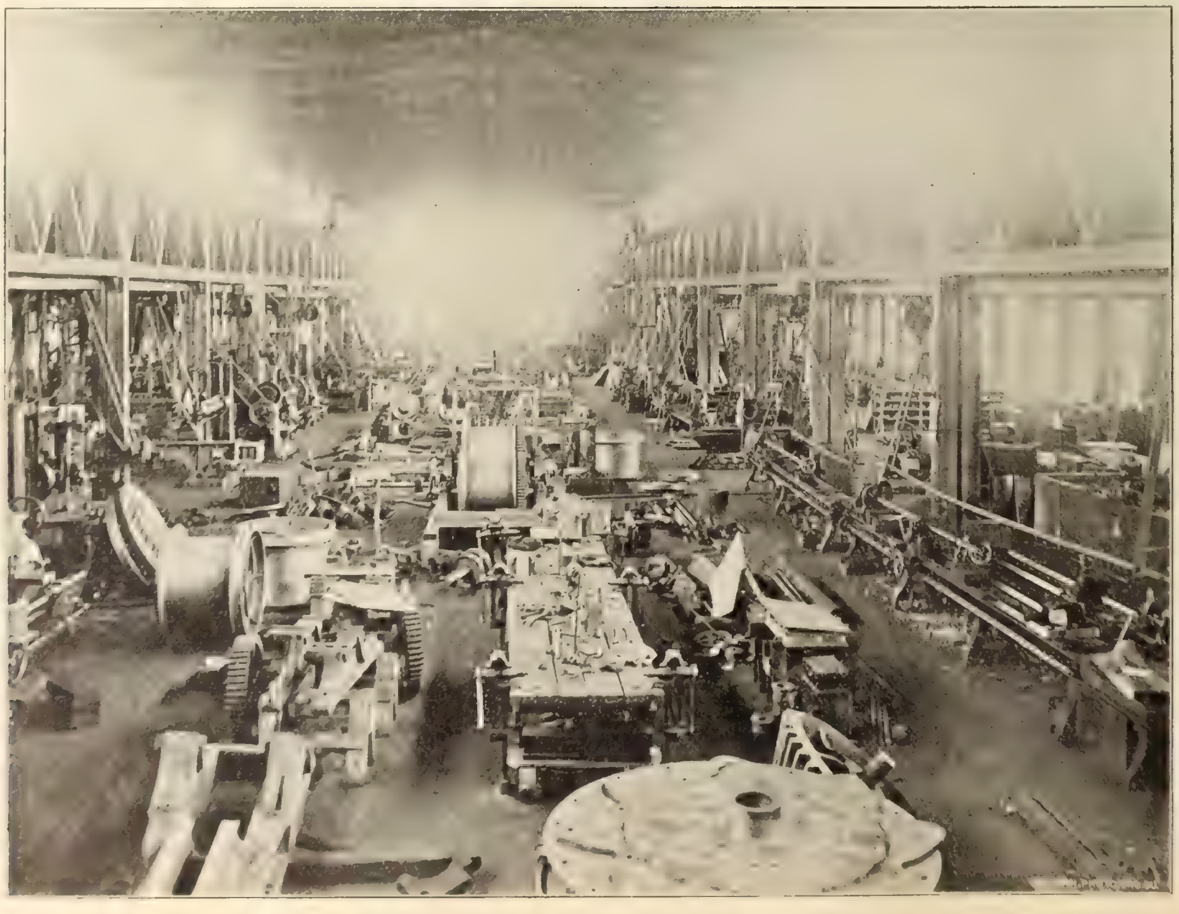
Passing through to the boiler shop, I found men working in the buildings, on cars and in the yard, in a labyrinth of steel penstocks of varying sizes, and amid a din of steel on steel that rendered talking useless.

We walked through the shops, and I noticed half a dozen large boilers, seven feet in diameter, nearly finished apparantly, and when we reached the open air, where I could hear my informant, he stated that there were then twenty-five or so boilers on order, from seventy to two hundred h. p. and carrying a working pressure of from 100 to 150 lbs. steam.

Nearly a full half mile of steel penstock, ranging in size from eight to sixteen feet in diameter, was being made and set up by workmen from the shops of the Jenckes Machine Company, the territory extending from Nova Scotia to Western Ontario, and most of the penstock work being to supply water to Crocker turbines.

The departments for machinery for the development of electricity naturally interested me most, but in passing through the foundry, a large brick building, some eighty by three hundred and forty feet, I saw an electric crane swing up the pattern for the large crusher made last fall for the Granby Smelter in British Columbia. There was, it may be remembered, considerable newspaper mention made at the time about the size and weight of that crusher, weighing, as it did, 113,000 lbs., and being, so far as is known, the largest crusher in the Dominion. Its capacity is 1500 tons of ore per ten hours, and a letter from the superintendent of the smelter, which I saw, stated that so far they had been unable to bring ore enough to the crusher to run it to its full capacity.

I might continue, and mention the other mining machinery, the pulp mill and saw mill machinery of various kinds, which keep over 400 men working, but lack of space forbids.— J. R. H.



The Jenckes Machine Company—A Portion of the Erecting Floor.

ANTI-FRICTION BEARINGS.

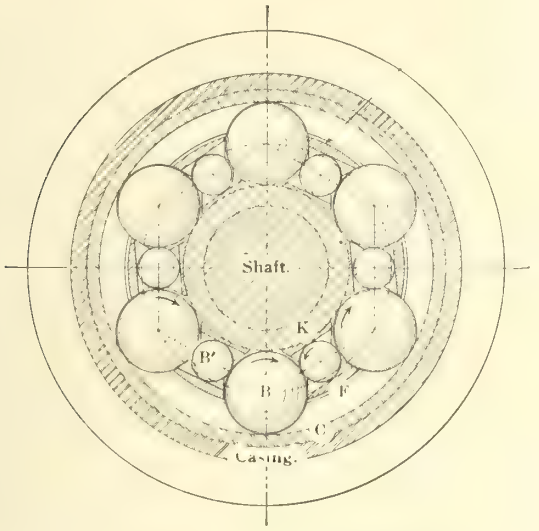
Electrical men and engineers generally are now beginning to turn to the great frictionless bearings. "To reduce friction is to create power." This saying is well-known to all, and, while in the past the pulleys and the belts have been receiving attention, we are now beginning to get something as " frictionless as the wheels of the universe."

Of roller and ball bearings now prominently before the Canadians, the principle ones are the Chapman Double Ball Bearings, the Henderson Roller Bearings and the Hiatt Roller Bearings.

The Chapman double ball bearing is the invention of Mr. C. H. Chapman, and it has already begun to change the system of transmitting power. A visit to the Chapman Double Ball Bearing Co.'s office at 39 Scott street, Toronto, shows a splendid demonstration of the great merits of this invention. The discovery was almost by accident. A trial of the ball bearings and a track record lowered.

All these bearings are for the purpose of reducing friction in all moving parts of machinery. Friction is the bugbear of manufacturers and owners of rolling stock and the devourer of dividends.

By referring to the cut below it will be seen that B is the load-carrying ball, B′ the idler ball, F the retaining float for B′, C the cup and K the cone. The idler B is so placed that its centre is coincident with a line connecting the centres of each of the adjacent carrier balls B, and is positively held in position by a loose free ring F that floats with the carrier balls and is supported on the cone or shaft but not in contact with any of the balls when the same are under load, during which time the idler balls are maintained in the same relative position by rolling contact with the carrier balls.



THE CHAPMAN DOUBLE BALL BEARINGS.

Electric street railway men are interested in the Chapman double ball bearings because it has been demonstrated successfully that they will stand up under weight when applied in accordance with the ideas of the invention, which bearings are now in use and giving perfect satisfaction.

In the Orswell Mills, at Fitchburg, Mass., 300 feet of line shafting, equipped with these bearings, running at a speed of 600 revolutions per minute, has been in operation two years without lubricant and without any sign of wear. The load on this was 125 h. p. The saving in power here was 23½ per cent.

The Minister of Railways and Canals has authorized the equipping of one of the express passenger trains and engine on the Intercolonial Railway with the Chapman apparatus. Plan of this is on exhibition at the company's office.

The illustration upon another page of a street railway car equipped with these bearings will be noted by our readers. This car has been in use for over a year and a half and in a recent examination by Mr. Muhlfeld, the Mechanical Superintendent of the Intercolonial Railway, no sign of wear or heat whatever could be found in the bearings. It has been examined and tested by the best experts and has shown a saving in power of over 60 per cent., and this without any lubricant.

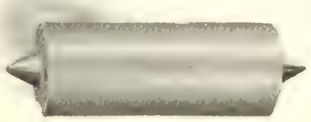
One of the gravest problems involved in the steam turbine or rotary engine has been that of a proper bearing for the extremely high rotative speed of the main cylinder shaft. The shafting of a Parsons steam turbine on one of the Warren Line steamships by the use of the Chapman double ball bearings showed a remarkable demonstration in their favour. From a defective service of 3600 revolutions per minute using a great quantity of oil, the Chapman bearings run the turbine 4200 revolutions per minute and no oil used. An emery grinder spindle has been run daily for over a year at a speed of 1600 revolutions per minute, no oil used, and are as perfect to-day as ever.

A visit by our representative to the Henderson Roller Bearing Mfg. Co.'s Works at 66 Esplanade W., Toronto, revealed a very busy hive of industry. Here is employed nearly fifty men in the three storeys of the large factory. The different parts of the Henderson roller bearings are here seen in the various stages of manufacture.

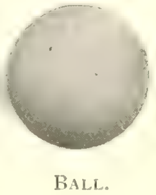
The large gas and coal furnaces used to harden the castings are running full blast, turning out hundreds of these bearings to fill the orders already in hand.

The place is well worthy a visit from visiting electrical engineers or others interested in roller bearings.

A visit to the head offices of the Henderson Roller Bearing Co. in the Temple Building gave an opportunity to see the various models and roller bearings, the invention of Mr. Henderson, a Canadian. These bearings have already attracted world-wide interest and the success of the company was from the very first an assured fact.



ROLLER.



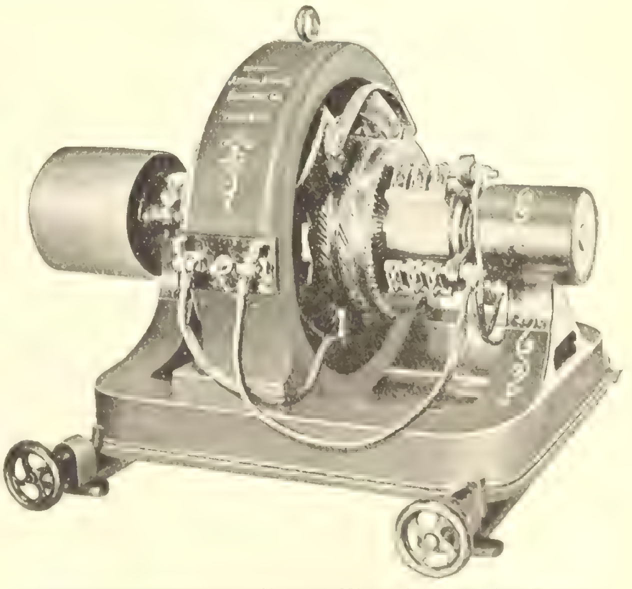
BALL.

The Henderson Roller Bearing is one of the most satisfactory anti-fricton bearings ever presented to the public. The rollers are held in alignment with the minimum amount of friction, and the end thrust is provided for by an almost frictionless, yet durable means. Bearing surface is provided proportional to the weight to be carried, so that no indentation of the metal occurs. By referring to the cut on this page the relative bearing surface of the ball and roller will readily be seen.

Up to the present time the railroads have been using the ordinary brass journal for their rolling stock, and considerable difficulty has been met with because of hot boxes, while in frosty weather the congealing of the oil increases the friction, and thus lessens the hauling capacity of the engine. The use of roller bearings is particularly adapted for railroad purposes.

The wonderful saving in power of the Henderson roller bearings has been demonstrated. With a weight of 64 tons upon the ordinary brass journal 3200 lbs. power was required to start it in motion, 2012 lbs. was required to keep it running, while with the bearings only 960 lbs. was required to start it and only 300 lbs. to keep it in motion—an average saving of more than 75 per cent. of power. A compressed air engine now accomplishes work with a pressure of 25 lbs., which on the ordinary journal requires 110 lbs. pressure to do the work. This table has been in constant use for ten months carrying up to 95 tons at times, requiring no oil and no attention.

The above shows the bearings as put to a severe test upon an electric generator revolving at a rate of from 1000 to 1200 revolutions per minute and carrying a load equal to 60 h. p. At the company's office is a splendid test of the end thrust bearing, used in conjunction with the rollers. 1100 pounds weight can be easily turned with the thumb and finger at the center of the hub.



ELECTRIC GENERATOR FITTED WITH ROLLER BEARINGS.

This is also adapted for upright shafting, centrifugal bearings, boat propellers, &c.

In this age, when so many of our factories are run by electric power, the reduction of the friction in shafting has become a very important consideration.

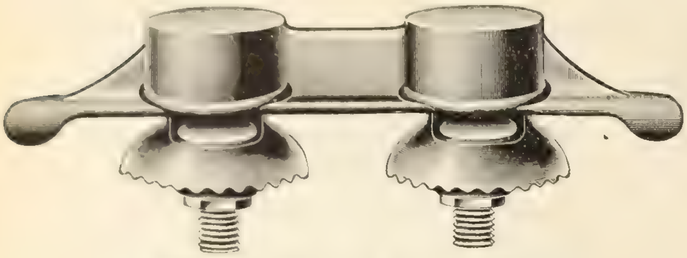
The adoption of ball or roller bearings generally will mean a saving of from 50 to 75 per cent. in power in the factories of our country. It is to be hoped that Canada will utilize this great invention and develop her growing industries.

J. R. H.

GREAT NEW ENGLAND SUPPLY HOUSE.

The tremendous growth in the application of electricity, or rather in the use of electrical appliances, is nowhere more apparent than in the spacious store and ware—rooms of the Stuart-Howland Company at Boston.

A little more than three years ago this company was organized and started business with a comparatively small but well selected stock of lighting supplies. Within a few weeks the agency for the well-known Russell-Tomlinson telephones was secured, and a telephone department added ; then seeing the urgent demand for street railway supplies several agencies of well-known manufacturers were secured ; a stock was purchased and a street railway department opened. New salesmen were added frequently, in fact we are told that whenever a specially able salesman applied for a position he was promptly engaged and a place made for him.



Gun Type, Straight Line Suspension.
Stuart-Howland Company, Manufacturers.

Orders came pouring in, especially in the street railway department, and the manufacturers were unable to fill orders promptly ; customers clamored for their goods. The company, not to be outdone, secured the services of some well-known engineers and set to work to design ad manufacture a complete line of overhead and pole equipment. Having the benefit of the experience of other makers the designers were able to avoid weakness in construction and yet not increase the aggregate weight.

The result of their work is shown in six different types of overhead insulation, 12 types of bracket arms, 15 or 20 of ears, and as many more of trolley wheels, as well as a great variety of other appliances used in the construction and maintenance of street railways.

The entire line is symmetrical, substantial,and carefully made. In proof of this the company claim that although last year they sold and delivered over 1000 miles of complete overhead and pole equipment (excepting wire) of their own manufacture, all of which was fully guaranteed, not one complaint was received,nor was one piece returned as defective.

Being unable to take care of all their orders last year, and to avoid a repetition this year, they have been making up stock during the winter. They have now on hand and ready for shipment 18,000 bracket arms, also hangers, globe strains, ears, trolley wheels, signal strand, cross arms, cross arm braces, etc., in like proportion.

The business of this company has grown from a small beginning three years ago to be one of the largest of its kind in the world, with branches in New York, Cleveland, London and Paris. Their stock at Boston includes practically everything electrical, and all standard lighting, telephone and street railway supplies are carried in large quantities. Some of the company's specialties are illustrated on this page.

Cap and Cone Type, Double Curve Suspension.
Stuart-Howland Company, Manufacturers.

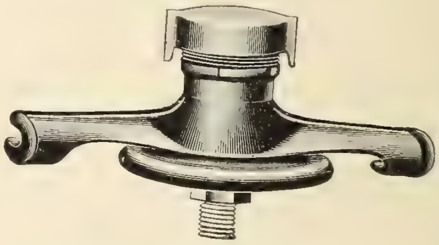
The Vancouver Electrical Works, of Vancouver, B. C., intend to build direct connected marine outfits up to 150 lignts capacity. The manager is Mr. J. Shipton.

TELEPHONE COMPETITION.

A committee was appointed by the city council of Hamilton to visit several American cities in quest of information as to telephone competition. This committee recently made its report, which contains is summed up in the following conclusions : "It is not desirable for any community to have competition in telephones unless it is to regulate some very grave evil. The almost universal experience has been that competition raises the rates materially to business and professional men, and lowers the rate somewhat to a resident. Competition in ordinary lines of business may be a good thing, but your committee is of the opinion that in telephony the rates should be regulated by some other means, competition being costly and up to the present time somewhat in the nature of an experiment. Government ownership of the telephone trunk lines, with local ownership of the local lines, would be one solution of the difficulty, and probably the very best solution. Absolute government control of all telephone lines would be another solution. Government control of the rates would probably be the most natural solution of the present state of affairs in Canada. If the government controlled the trunk lines, the municipalization of the local lines would be a comparatively simple matter, but with the trunk lines in the hands of the Bell Company, and also the local lines in the hands of the Bell Company, the installation of a municipal plant would be merely the introduction of competition."

RUNNING A GAS ENGINE.

In starting and running a gas engine there are several points which the attendant must look out for. An oil cup may run dry or get stopped up. A lock nut may work loose on a valve stem and, if not looked after, may wear off the cotter pin above it and allow the valve to drop into the cylinder. An ignitor wire may work out of the terminal nut and become grounded, thereby shutting down the engine. This last would not happen if the set screw in the terminal nut had been clamped down on the wire. A trip stem nut may work loose, so as to prevent contact taking place between the points of that ignitor, thus causing the cylinder to miss fire, or it may move in the opposite direction till it allows the points to remain permanently in contact, thus short-circuiting the other ignitors and causing a shut down.



Boston Type, Straight Line Suspension.
Stuart-Howland Company, Manufacturers.

An advantage of a two or three cylinder engine is that a failure of one cylinder does not cause the engine to stop, and many small derangements may be cured while running. An exhaust valve may leak and need grinding. An agitator may become grounded by moisture or carbon. A battery may become exhausted and need renewal. A bearing may need keying up. Backfiring is the ignition of the explosive mixture before it has entered the cylinder. A sharp explosion and a jet of flame from the air inlet usually accompanies it. That may be caused by a bad mixture of gas and air, burning so slowly that flame hangs in the cylinder during the whole of the expansion and exhaust stroke, thus igniting the incoming gases when the valve opens. Or more rarely, a leaky inlet valve may allow the explosion flame to shoot into the mixture outside and ignite it. Backfiring should be cured, for it checks the speed of the engine and sooner or later necessitates new inlet valve springs. By driving the inlet valve down till the spring comes solid it often wedges one coil sideways over another, thus crushing them together and decreasing the lifting power of the spring.

The power plant at Ragged Rapids, owned by the town of Orillia, Ont., has been assessed for $25,000 by the assessor in Matchedash. The town has entered an appeal on the ground that the property of one municipality is not taxable in another municipality.

SPEED OF MOTOR VEHICLES.

A bill has been introduced in the Ontario Legislature by Mr. Preston to regulate the speed and operation of motor vehicles on highways. It provides also for the payment to the Government of a nominal registration fee. The provisions as to speed are as follows :

No motor vehicle shall be run upon any public highway within any city, town or incorporated village at a greater rate of speed than ten miles an hour, or upon any public highway outside of any city, town or incorporated village at a greater speed than fifteen miles per hour, unless authorized to do so by by-law of said municipality.

No person shall drive a motor vehicle upon any public street, public highways, public roads, parks, public parkways or public driveways in this province in a race or on a bet or wager.

Every person having control or charge of a motor vehicle shall, whenever upon any public street or way and approaching any vehicle drawn by horse or horses or any horse upon which any person is riding, operate, manage and control such motor vehicle in such manner as to exercise every reasonable precaution to prevent the frightening of any such horse or horses, and to insure the safety and protection of any person riding or driving the same. And if any such horse or horses appear frightened the person in control of such motor vehicle shall reduce its speed, and if requested by signal or otherwise by the driver of such horse or horses, shall not proceed further towards such animal, unless such movement be necessary to avoid accident or injury, or until such animal appears to be under the control of its rider or driver.

Upon approaching a crossing of intersecting ways, and also in traversing the crossing or intersection, or in crossing a bridge, the person in control of a motor vehicle shall run it at a rate of speed less than that specified, and not greater than is reasonable and proper, having regard to the traffic and use of the intersecting ways or bridge.

CARE OF A GAS ENGINE.

There are a number of little things that may happen to a gas engine which the attendant must look out for. An oil cup may run dry or get stopped up. A lock nut may work loose on a valve stem, and, if not looked after, may wear off the cotter pin above it, and allow the valve to drop into the cylinder. An igniter wire may work out of the terminal nut and become grounded, thereby shutting down the engine. This last would not happen if the screw in the terminal nut had been clamped down on the wire. A trip stem nut may work loose, so as to prevent contact taking place between the points of that igniter, thus causing the cylinder to miss fire, or it may move in the opposite direction until it allows the points to remain permanently in contact, thus short-circuiting the other igniters and causing a shut-down.

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MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, June 1, 1903.

The Montreal Railway employees who struck about three months ago did so well that they thought they would repeat the dose and struck again just before the holiday (Victoria Day.) Luckily, the street railway decided that they had had enough nonsense and fought the strike to a finish. There are a few motormen and conductors now looking for a job and some others gracing the common jail as the result of intimidation and violence. The public were justly incensed against the strikers and patronized freely the cars run by non-union men. Although the average business man would as leave "loaf around the house" on a holiday, the ladies and children who usually take a run out to the suburbs were greatly inconvenienced. A prominent official of a Trades Union was heard to remark that he had long advocated a Canadian Union, and that this was the first blow and a heavy one to the International.

The honors were carried off by Mr. W. G. Ross, Secretary-Treasurer of the Montreal Street Railway, who stood to his guns and would brook no interference from either unions or conciliators, either of the aldermanic or Mulock variety. Mr. Resin Orr represented the Yankee end of the stick and has lost both ways. "Resin" is said to be a semi-transparant and rather brittle substance ; so his "strike" and "International" got broken, and the majority of the men have seen through the little game of sending their money to the United States to help Waterbury, Bridgeport, and other strikes.

Now that business is again normal, Mr. W. G. Ross promises the men a substantial subscription to their Mutual Benefit Society, which it is understood they are now forming ; and will not allow any vindictive feeling to be shown the strikers, who have seen the error of their ways and are back on duty.

The Electrical Workers Union declared a strike about May 23 on the Montreal Light, Heat and Power Company affecting about one hundred employees, chiefly line men. As the manager had repeatedly stated that he would meet a deputation of bona-fide employees, and would not treat with the union as a union—the more especially as it is practically a branch of a U.S. organization—many of the men can blame themselves if they find it impossible to get their positions back again later. Everything points that way now.

The City Council have brought up the underground conduit question again, claiming that owing to the amalgamation of the companies there would now be no divergent interests, and that if such were built by the city and leased it would bring in a "handsome" revenue to the city. The word "handsome" sounds as if it were intended to bleed the electric companies to provide the city with revenue, and spoils the whole preamble. The need of such a conduit is obvious to any person, and the argument of one common interest is also good; but if it is going to mean extortionate rentals they will find a surprise party in the shape of considerable opposition, not to speak of the franchises granted by the legislature.

Mr. Chas. Morton, manager of the Standard Light and Power Company for many years, has severed his connection since consolidation. Mr. Morton's regime was successful, the balance sheet showing on the right side, and many of his old customers will miss the well known face when they go to transact their business. The accounting department for the Standard Company is already turned over, and bills are now payable to the Montreal Light, Heat & Power Company.

SPARKS.

The Council of Windsor Mills, Que., have decided to install a municipal electric light plant.

The Bell Telephone Company have built two copper metallic lines between Magog and Georgeville, Que.

The New Brunswick Telephone Company have decided to install a telephone exchange at St. Andrews, N. B.

The town of Sackville, N. B., proposes to issue debentures for the purpose of purchasing the electric light plant.

The Ottawa Electric Railway Company has a bill before the Legislature increasing its borrowing powers to $1,000,000.

An act has been introduced in the Ontario Legislature providing for the extension of the Guelph Street Railway and for changing the name to the Guelph Radial Railway.

The International Carbon Company, of Toronto, has been incorporated, with a capital of $15,000, the provisional directors being Messrs. George J. Castle, S. W. McKeown and J. J. Seitz.

The Chippewa Electric Company, the purchasers of the Algoma Electric Company's stock and business at Sault Ste. Marie, have secured the contract for wiring the new Grand Trunk freight sheds at North Bay.

The Whitney Electrical Instrument Company, of Concord, New Hampshire, recently lost almost their entire plant by fire. It is understood that arrangements have been made to rebuild immediately.

Mr. J. W. Nesbitt, K. C., solicitor for the Hamilton, Caledonia & Lake Erie Railway Company, says the construction of an electric railway will be commenced as soon as sufficient stock is subscribed.

Mr. A. Heathcote is in charge of the engineers who are surveying for an electric railway to extend from Winnipeg to Selkirk, Man. The capitalists behind the scheme belong chiefly to Winnipeg.

The town of Lucknow, Ont., will likely purchase the electric light plant from the owners and install a modern system. Mr. H. F. Strickland, electrical engineer, of Toronto, has the matter in hand for the town.

Mr. H. P. Dwight, general manager of the Great North-Western Telegraph Company, Toronto, recently returned from New York, where he conferred with the Western Union Telegraph Company in respect to proposed extensions.

Mr. Michael Connoly, of Montreal, has secured the contract for the completion of the works of the North Shore Power & Railway Company at Seven Islands, Que. The contract includes the building of a railway, wharves, pulp mills, etc.

Clarkson School of Technology Thos. S. Clarkson Memorial, Potsdam, N.Y.

Courses leading to degrees of Bachelor of Science in Civil, Electrical and Mechanical Engineering, comprising four years of thorough training and resident collegiate work in theory and practise of engineering. Well equipped shops, laboratories, drafting rooms and power plant. Located near Massena and the engineering developments along the St. Lawrence River. Healthful climate. Tuition moderate.

WM. S. ALDRICH, Director

ELECTRICAL REPAIRS

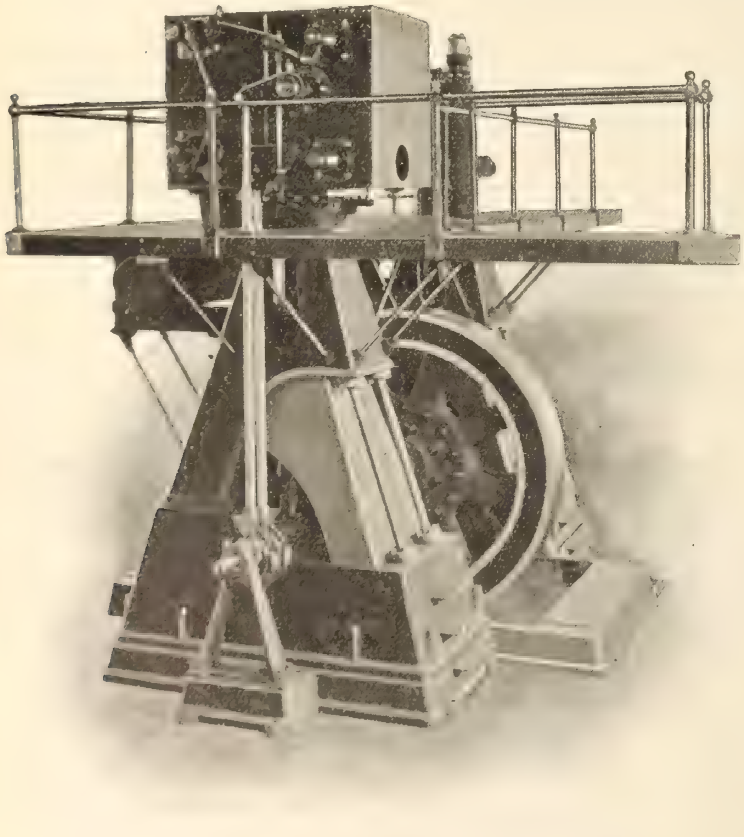
In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

MESSRS. FRED. THOMSON & CO.

774 Craig Street, MONTREAL, P.Q.

have arranged their works for repair work only. They keep armatures of nearly all makes of dynamos in stock, which they loan while repairs are being made. Their factory is so arranged that they can run night and day, and work can be finished in the shortest possible time. Telephone Main 3149.

THE LAURIE ENGINE COMPANY
MONTREAL, CANADA.



Some Laurie Corliss Installations:

British Columbia Electric Ry. Co. - 2,100 H. P.
Winnipeg Electric Street Ry. Co. - - 2,200 H. P.
Toronto Electric Street Ry. Co. - - 1,500 H. P.
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Dominion Iron & Steel Co. - - 2,400 H. P.
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500 P. H. Laurie Vertical Cross Compound Electrical Engine.

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MR. A. M. WICKENS,
Chief Engineer The Canadian Casualty & Boiler Insurance Company.

MR. A. G. C. DINNICK,
Managing Director The Canadian Casualty & Boiler Insurance Company.

This company, as its name implies, has been founded for the purpose of a general accident business as well as boiler insurance and inspection, and has in the short time of its existence already stablished itself well in the insurance world. This is scarcely to e wondered at in view of the fact that the directors of the comany have spared no endeavors to make the staff of the company thoroughly competent and efficient one. The managing director, Mr. A. G. C. Dinnick, himself a man of great business experience and ability, has a special gift of choosing good men for the various departments of his institution. The chief engineer of the company, Mr. A. M. Wickens, is a gentleman without a peer in his profession. Until recently he held the position of chief engineer of the Public Works Department of the Ontario Government, as well as Inspector of Boilers in the Government Institutions. He resigned this position in order to accept the appointment offered to him by the Canadian Casualty and Boiler Insurance Company as their chief engineer. With an expert like Mr. Wickens at the head of the engineer's department it is safe to say that the interests of the insurers will be well looked after, as everybody knows how important is periodical inspection by a competent and experienced engineer. As an engineer erecting and operating steam plants, Mr. Wickens brings expert practical knowledge to bear upon his deliberations as chief of the engineers' department of the Canadian Casualty and Boiler Insurance Company.

The efficiency of the engineers' department enables this company to extend its operations in a way few other companies can follow. The company is in a position to give expert advice upon the erection of any kind of steam or electrical plants, a feature which interested parties will presumably be quick to take advantage of.

The public have been quick to recognize the advantages offered to them by this company, and the amount of policies written is the best proof of this contention. With the energetic management and the practical knowledge combined, the Canadian Casualty and Boiler Insurance Company is sure to take a leading place in its class of business in the very near future.

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SEND US YOUR SPECIFICATIONS

We also manufacture a full line of Knife Switches, Time Switches and the Hill Automatic Switch

The Hill Electric Switch Co., Limited, 426 St. Paul Street MONTREAL

TRADE NOTES.

J. C. Wilson & Company, Glenora, Ont., have under construction two 33 inch vertical "Little Giant" turbines for Stuart Bros., Mitchell, Ont., who are making some improvements in their flour mill.

The two 600 h. p. vertical cross-compound engines which the Robb Engineering Company are supplying for the Nova Scotia Steel Company's plant at Sydney Mines will be fitted with the new Armstrong Corliss valve gear and Robb governors. The engines are to be direct connected to Canadian General Electric generators.

J. C. Wilson & Company, Glenora, Ont., announce the following recent shipments of "Little Giant" turbines. Note their destination and you will see how fully they cover the country—Wm. Henstridge, Notch Hill, B. C., a 6-inch vertical; Jno. Warcup, Lemisurier, Que., a 16-inch vertical; J. H. Mullen, Bear River, N. S., a 12-inch vertical; Frank Saunders, Gander Bay, Newfoundland, an 18-inch vertical.

PUBLICATIONS.

The General Electric Company have issued a neat booklet descriptive of the various types of fan motors.

Messrs. James Hope & Sons, of Ottawa, have issued a new publication entitled "The All-Red Line," the editor of which is Mr. George Johnson, Dominion Statistican. The design of the publication is two fold, 1st, to place on record in a convenient form the annals of the Pacific Cable project in which from first to last Canada has taken such a conspicuous part; and secondly, to educate and mould the public mind in all the King's possessions around the world in respect to a much larger subject in which Canada with the whole Empire is immensely interested.

SPARKS.

The electric railway from Brantford to Paris, Ont., was opened on May 12th. The fare for the round trip is thirty cents.

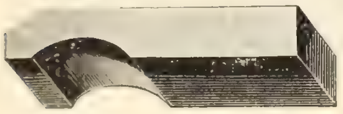
By a vote of 79 to 1 the ratepayers of Gravenhurst, Ont., have decided to purchase the electric plant from the Gravenhurst Electric Light Company.

Mr. Judd is actively pushing the preliminary arrangements for the construction of an electric railway connecting Kingston, Gananoque, Perth, and Lanark. The line would be 47 miles in lengtht and would cost about $10,000 per mile.

A new system of telegraphy has been tested between the post offices of London and Glasgow. By the new method twelve messages can be sent over the same wire simultaneously, and the number can be doubled by the duplex method of transmission.

Port Colborne and Thorold parties have asked the Dominion Government to incorporate the Erie Ontario Power Company, The bill is being opposed by the Hamilton & Lake Erie Power Company, on the ground that the proposed field of operations is the same as that covered by their charter obtained about two years ago.

SWEDISH CHARCOAL IRON SHEETS, BARS, RODS, STRIPS AND STAMPINGS.



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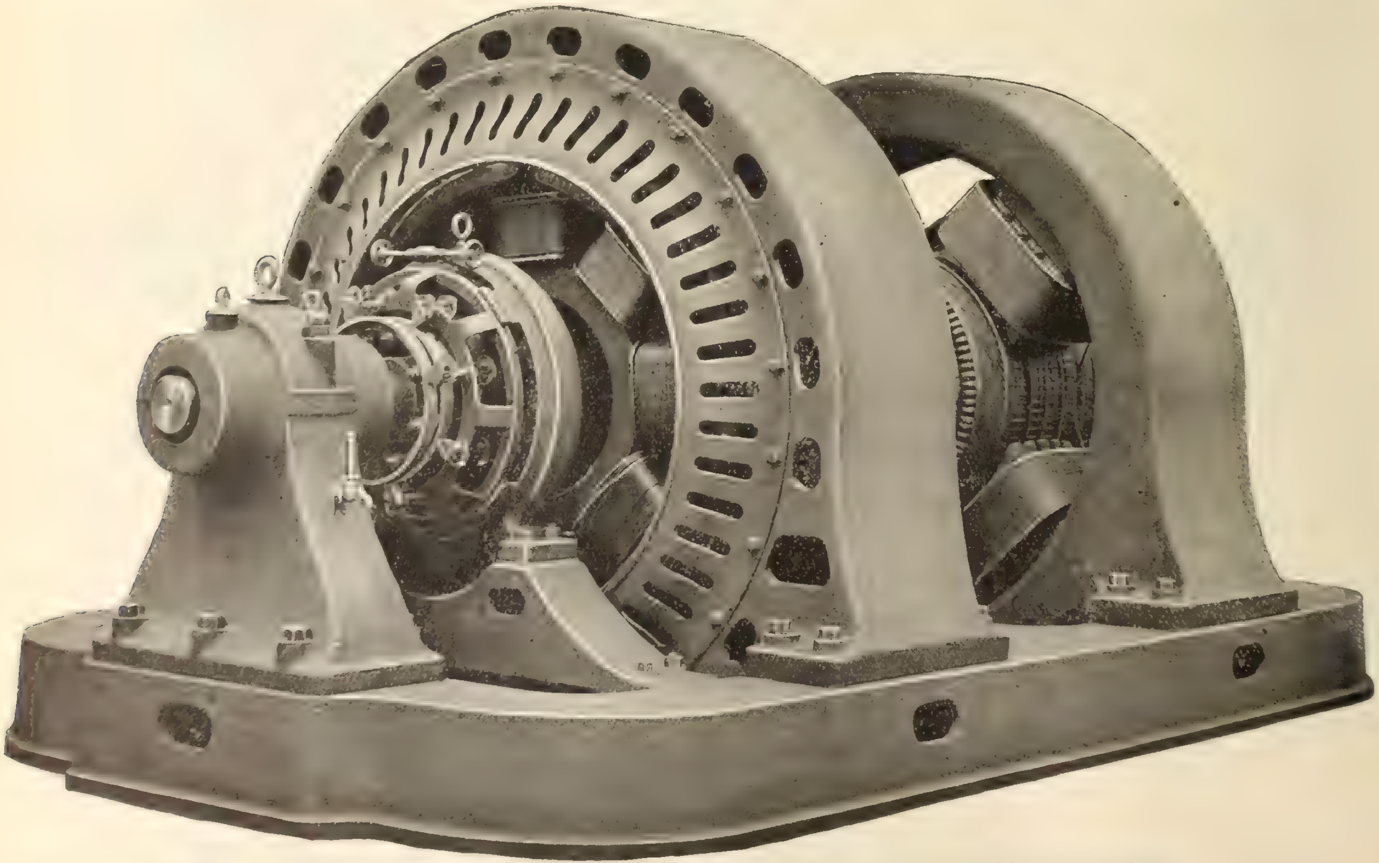


Head Office: 110 Cannon Street, LONDON, E. C, ENGLAND
Canadian Agent's Office: 332 King Street, KINGSTON, ONT.

WINDING OF WESTINGHOUSE TRANSFORMERS.

Oil-insulated self-cooling transformers may be wound for practically any voltage desired. The following high tension voltages, however, have been adopted as standard: 2200, 6600, 11000, 16500, 22000, 33000 and 44000. Taps are brought out from the high tension winding for three lower voltages. This provision makes it possible to use duplicate transformers at both ends of the transmission line, the taps on the lowering transformers accommodating them to the reduced line voltage. The following table shows the exact voltages for which Westinghouse standard transformers are wound:

STANDARD VOLTAGES FOR OIL-INSULATED SELF-COOLING TRANSFORMERS.

2200	6600	11000	16500	22000	33000	44000
2100	6300	10500	15750	21000	31500	42000
2000	6000	10000	15000	20000	30000	40000
1900	5700	9500	14250	19000	28500	38000

Transformers of a capacity not exceeding 150 k. w. may be wound for voltages as low as 50, and the larger transformers for voltages as low as 100. Either or both windings may be divided into two equal parts so arranged as to permit either series or multiple operation, the change being effected by a simple rearrangement of connectors on the terminal block. Taps may be brought out from the low tension winding for ample variation in both voltage and ratio, and are provided for a total of five voltages, full voltage, 5 per cent. and 10 per cent. less than full voltage, half voltage, and 5 per cent. less than half voltage.

As showing the remarkable extension of street railways and electric railways in the United States, the census preliminary report of that country on that subject is eloquent. It shows that in the last ten years their mileage has increased 187.85 per cent., the number of passengers carried 137.94 per cent. The number of miles operated by animal power shows a decrease of 95.42 per cent., 259 miles being so operated at the present time.

Packard Type "G" Recording Watt Meters

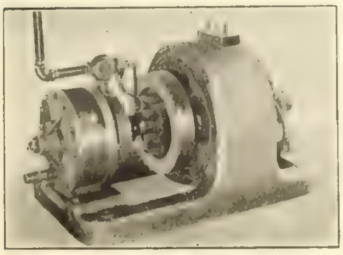
The immense number of orders we have filled in the past 18 months for this meter illustrated here is ample proof of its superiority.

It is unquestionably the most sensitive meter on the market as well as the fairest to both consumer and central station, and station managers who desire pay for all current consumed and no more will do well to investigate the merits of type "G".

Its sensitiveness can be no better illustrated than in the fact that it will measure the current consumed when a Hylo Lamp is burning on its baby filament.

The Packard Electric Co., Limited,
Montreal St. Catharines

Direct Current Multipolar Generators



Direct-Connected to a throttle-governed Sleeper Engine.

INDEPENDENT UNITS

For your FACTORY, your SAWMILL, your STORE, your YACHTS and your STEAMERS, your COUNTRY-HOUSE or your HOTEL.

The armatures will not heat.
The commutators will not spark.
The control is automatic, there is no fluctuation of light.
Taken altogether they are the most efficient and the most perfectly automatic units ever offered.
Compact and light—space and weight minimized.

Write us for particulars, catalogs and prices.

The SLEEPER ENGINE COMPANY, Limited
Office and works, corner Darling and Notre Dame Streets, Montreal

LEGAL DECISIONS.

Ottawa Electric Company vs. Birks & Sons.—This was a test case wherein the Ottawa Electric Company wished to ascertain whether the contracts, which are made with customers, are equally binding upon their custmers as upon the company. In this case Messrs. Birks & Sons had had some negotiations with the company with a view to some changes in the arrangements and on this account held that the contract had been voided and that it was otherwise informal. The court sustained the company's claims, and there will now be no doubt as to their ability to enforce the contracts which are made with customers.

Ottawa Electric Co. v. City of Ottawa.—A. B. Aylesworth, K. C., and T. McVeity (Ottawa), for defendants, appealed from judgment of Boyd, C. (1 O. W. R. 508), allowing appeal of plaintiffs and dismissing appeal of defendants from report of local Master at Ottawa. The action was brought by plaintiffs to recover $18,669.50, alleged to be due by defendants, for electric lighting of the City of Ottawa under a contract. The controversy was as to the legal relationship of the parties in consequence of the destruction of the works of plaintiffs, in common with a large part of the City of Ottawa, by the great fire in April, 1900. The Chancellor read the contract as meaning that if no light was furnished from unforseen accident there was to be no pay and no penalty during such time; when light began to be furnished pay began pro tanto, the company all the while being in no default.

Mr. George Foss is superintending the installation of the municipal electric plant at Windsor Mills, Que.

It is the intention of the Engineers' Club of Toronto to make a two days' visit to Peterboro this summer, to inspect the hydraulic lift lock now nearing completion and other engineering features in the vicinity of Peterboro. Mr. J. A. Culverwell has promised to provide a trip by steamer on the back waters, and it is probable that a formal reception will be tendered the society by the Council. The date of the visit has not yet been fixed.

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SYRACUSE BABBITT METALS
Which are the best for all machinery bearings, also wire and bar solder. We purchase scrap copper wire and brass scrap.
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"TRITON"
—MARINE—
Gasoline Engine
Simplest, Safest and Most Reliable.
Hamilton Motor Works
Hamilton, Canada.
258 Catharine Street North.
"Engines in successful operation from Halifax to Vancouver."

CHASE--SHAWMUT COMPANY
390 Atlantic Avenue, BOSTON, MASS.
MANUFACTURERS OF . . . . . . Electrical Specialties
RELIABLE DURABLE EFFICIENT ECONOMICAL
"Shawmut" Tested Fuse Wire and Links
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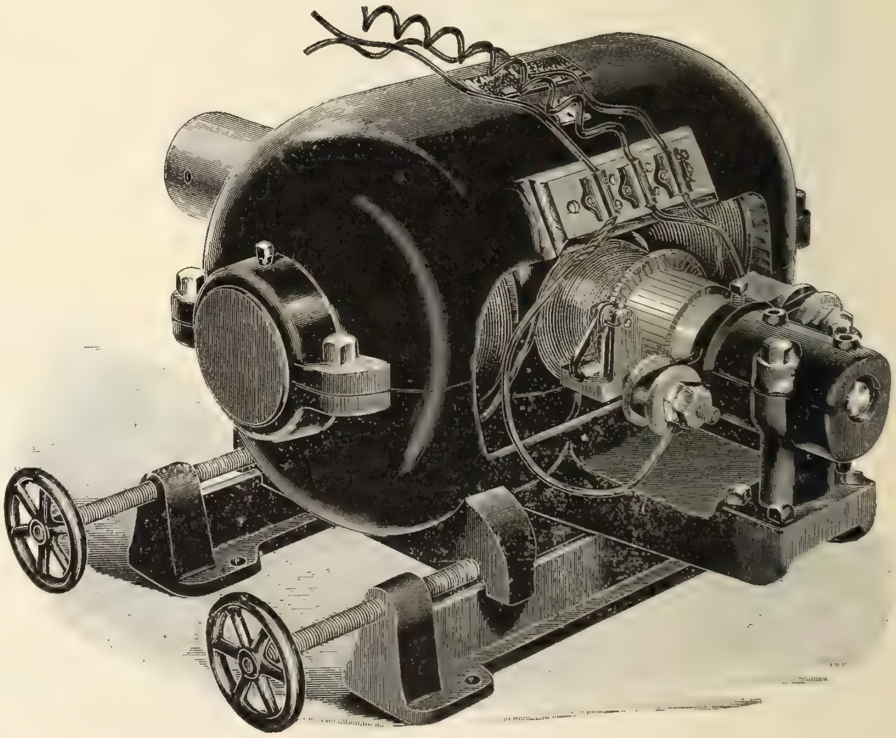

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BUILT ONLY BY THE . . . . CONSOLIDATED ELECTRIC CO., Limited.
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Cold Water Paint for Outside and Inside Use.
Weather Proof.
Fire Proof.
Standard; Matchless Quality.
LYTHITE TRADE MARK
White and Colors.
Durable.
COLOR CARDS AND PARTICULARS FROM
W. A. FLEMING & CO.,
771 Craig st., Montreal.

SPARKS.

The contract for building the tunnel at Niagara Falls, Ont., for the Toronto-Niagara Power Company, has been awarded to Mr. A. C. Douglass, who has carried out many similar undertakings. The tunnel is to be 2,100 feet long, with a sectional area of 514 feet.

Mr. J. H. Nellis, acting for the city of Woodstock, Ont., recently issued a writ against the Woodstock, Thames Valley & Ingersoll Electric Railway Company declaring that the company had forfeited its franchise and right on account of not completing the road to the east end of the city.

The city of Winnipeg is to have more light on its streets, for which purpose it has been decided to purchase a new dynamo with a capacity of 50 arc lights. Mr. F. A. Cambridge has reported that the cost of operating the electric lighting system for the fiscal year ending April 30, 1903, was $25,191.88.

The strike of the employes of the Montreal Street Railway has been declared off, the company winning on every point. While the strike was in progress a partial service was furnished, and as just punishment was meted out to the rioters, the strikers soon realized that it would be unwise to continue the fight.

Incorporation has been granted to the Stark Electrical System, Toronto, with a capital of $60,000. The provisional directors are Messrs. A. M. Stark, Herbert Waddington, Henry Blachford, J. C. Gardner, and W. N. Dollar. The company will manufacture the Stark device for supplying telephone communication, power and light over the same circuit.

A branch chapter of the American Institute of Electrical Engineers has been instituted at the rooms of the Engineers' Club of Toronto. The following are the officers: J. A. Kammerer, chairman; Prof. Rosebrugh, vice-chairman; R. A. MacKeen, secretary; Executive Committee, W. C. Hawkins, of Hamilton, J. Kynoch and Prof. Rosebrugh, of Toronto. Regular meetings will be held at the engineers' club rooms.

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When You See One?

May be you don't know about the good things we are making.
They combine all the latest improvements, unique designs.

TELEPHONES OF EVERY DESCRIPTION
WE GUARANTEE ALL OUR GOODS—TRY US

THE SAYER ELECTRIC COMPANY
12 and 14 Beaver Hall Hill, MONTREAL, Que.

FOR SALE

1-75 K.W. S.K C. Generator, 2000-1000 volts, 8000 alternations, with 2½ K.W. Exciter and Station Apparatus complete.

1-5 H.P. S.K.C. Motor, 8000 Alts, 500 volts, with necessary Transformer 1000-2000-500.

1-25 K.W. R. E. Co. B-iPolar D. C. Dynamo, wound for 110 volts, with sliding base, pulley, brushes, etc., complete.

2-12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.

The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address

THE VOLTA ELECTRIC STORAGE CO.,
39 James street South,
Hamilton, Ont.

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A B C Code, 4th & 5th Edition.
For Cables "Philips Eindhoven."

The
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Lamp

Manufactured by
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AT
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Maximum Light at Minimum Cost, coupled with unequalled Durability.

High and Low Voltage Lamps.
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(Specially constructed for running in Series.)
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Globular Lamps
Tubular Lamps
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Reflector Lamps
Etc., Etc.

Illustrated Catalogue free on application.

Daily Output 30,000 lamps

OPERATING FAN MOTORS.

In regard to the enquiry of "J. F." in May number, a subscriber writes: He will find a 125-cycle motor has 8 poles. By cutting each alternate one out, making the fields 4 pole, and then re-winding, he can get a fair slow speed 60-cycle fan, but commercially this would not pay. As to D. C. motor running on A. C. circuit, as most D.C. of any size are cast and not laminated, he will likely burn out his D. C. fan motor on A. C. current, but if he used a small battery motor of say 6 volts and put a suitable lamp in series, he could run such a D. C. motor on A. C. current of any frequency. This, however, is poor efficiency.

You might as well try to conduct a business without advertising as to operate machinery without oil.—Printer's Ink.

A committee of the City Council of Almonte, Ont., has recommended that the price of domestic lighting be reduced from ⅔ to ½ a cent per lamp per night, and that a reduction of 25 per cent. be made in the cost of commercial light; also that the incandescent lamps be in future sold at cost price, namely, 20 cents each. It is probable that at some future time the power for the electric light plant will be further developed to allow the committee to carry more lights.

A Fine Catalogue of
Nugent's Pat. Oiling Devices and Treatise on
"How to Oil an Engine"
will be sent free of charge upon request.

Write to
Wm. W. Nugent & Co.
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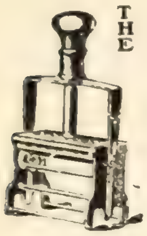

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Cor. Yonge and Adelaide Streets,
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Send for Quotations.

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MANUFACTURER OF
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AKRON, OHIO

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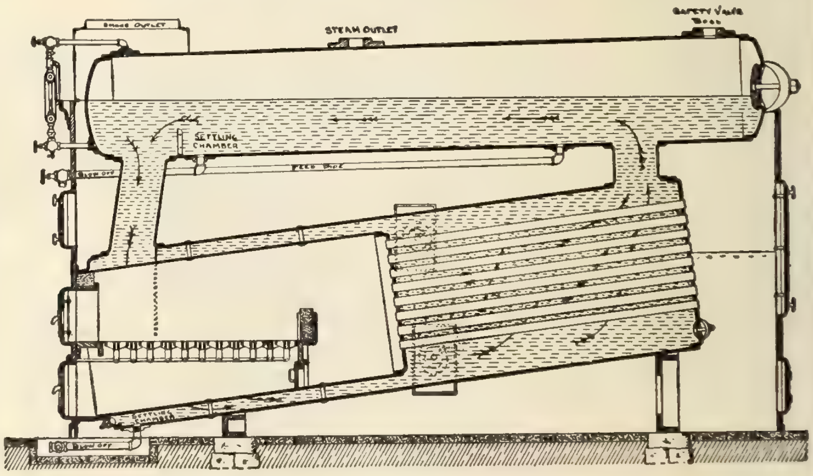
SELL ANYTHING
to the wholesale and retail hardware merchants and manufacturers
ANYWHERE
in Canada, you can reach them through
THE CANADIAN
HARDWARE AND METAL MERCHANT
MONTREAL and TORONTO
Circulates in Every Province.

THE MUMFORD STANDARD BOILER



A SUCCESS This boiler has been built by us for several years, and is used from the Atlantic to the Pacific with the most satisfactory results.

SAVES FUEL It has an internal fire box so that no heat is lost by radiation or by air leakage, and the water circulation is rapid and continuous.

EASILY CLEANED Two settling chambers are provided for collecting deposits of scale and all parts of the boiler are accessible for cleaning.

ROBB ENGINEERING CO., Limited,
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Agents: WILLIAM McKAY, 19 McKenzie Crescent, Toronto.
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Filled With Good Things

If We Make It Its Right

16 All-ways Always 16

Try Them and You Will Use No Other

The Sterling Electrical Manufacturing Co.

WARREN, OHIO

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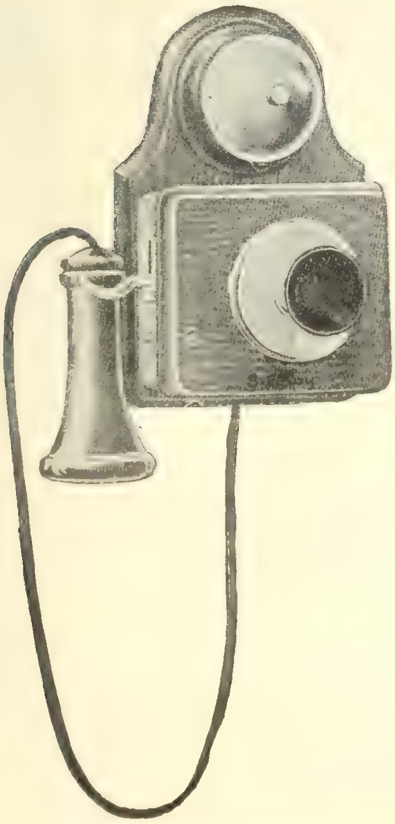
TELEPHONES



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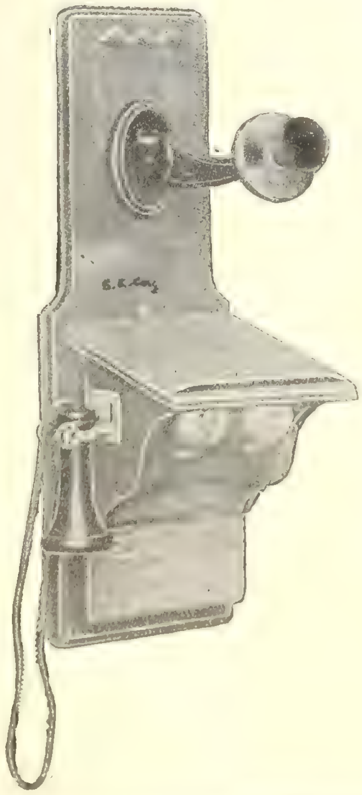


Central Energy Intercommunicative Telephones

A TIME SWITCH

For throwing lights off at any desired time. Sure in action, inexpensive. Something the general public want. No question about it. Sold to the trade at $5.00. A money maker.

We manufacture TELEPHONES and SWITCHBOARDS for all purposes and places. We shape our phones to your own ideas and claim to have the most up-to date phones in design and workmanship ever manufactured in CANADA.

WE HAVE A WEAKNESS FOR ANYTHING IN THE TELEPHONE LINE.

WRITE US IF YOU ARE INTERESTED

The Sayer Electric Company, 12-14 Beaver Hall Hill, **Montreal**

SPARKS.

The City Council of Goderich, Ont., propose to issue $3,000 of debentures for the purchase of electric light meters.

The Union Telephone Company purpose installing improved systems at Perth and Andover, N. B., this summer.

The Canadian General Electric Company have secured the contract for supplying 2,000 light generators for the electric plant owned by the town of Midland, Ont.

The City Clerk of Winnipeg, Man., desires tenders by June 8th for furnishing one 100 light direct-current dynamo, 50 direct-current enclosed arc lamps, 42 lamp hangers and five miles of No. 6 B. & S. wire.

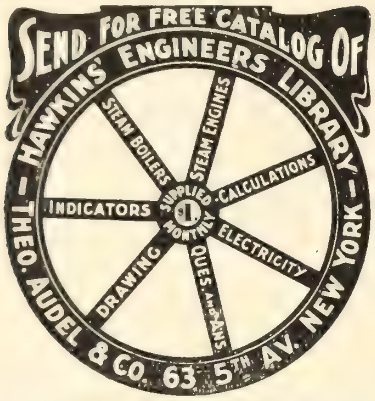
The Council of Peterboro, Ont., have offered the Peterboro Light & Power Company a contract for ten years from the time of the expiration of their present contract, for supplying 120 or more 2,000 candle power arc street lights at $50 a lamp per year, the company to pay the town $400 a year rental for the privilege of having their poles on the streets, and the contract per year to include Ashburnham in case the municipalities are united or any other additions to the town.

MICA & ROCK DRILLS

Miners and exporters of Electrical Mica, and sole agents for **Jackson Hand Power Rock Drill** and **Box Electric Rock Drill** for Canada.

JOHNSON, WILLATS & CO., 192 King Street West, TORONTO.

THIS SYSTEM IN YOUR OFFICE
means less work and less worry—few mistakes and no overtime. No matter what your business or profession, you should learn about it and at once.
Our experts together have written a book—**Shaw-Walker Systems**—and YOU should read it. Send for a copy to-day. It is free.
THE SHAW-WALKER COMPANY, Muskegon, Michigan.



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The address is 166, Fleet, London, Eng.

The cost is only 3d. per week including postage.

(Annual Subscription 20 Shillings.)

Moreover, regular subscribers are allowed to advertise without charge in the paper—See the rules.

Greer Tested Fuse Wire

EACH SPOOL IS PACKED IN A STRONG TIN BOX.
Full weight guaranteed to each spool.
Warranted to be absolutely uniform, reliable and accurate. Send for catalog.

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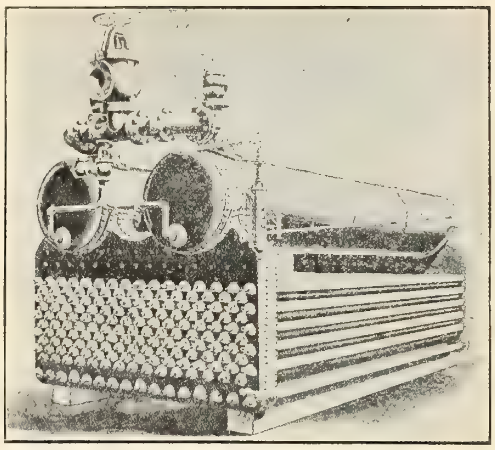
224-226 South Clinton Street
CHICAGO, ILL.



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JOHN J. MAIN, President and Manager.
Esplanade, Opp. Sherbourne St., Toronto
HIGH CLASS

Water Tube Steam Boilers

for all pressures, duties and fuel. From 75 to 600 h. p. each. N. B.—We do not make small boilers.
REFERENCES :— The Toronto Electric Light Co., Limited ; The T. Eaton Co. Limited ; The Massey-Harris Co., Limited, The Gutta Percha Rubber & Mfg. Co., Dominion Radiator Co., Central Prison, Foresters' Temple, Toronto City Hall, where boilers may be seen working.

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ELECTRICAL CONDUCTORS
FOR
RAILWAY FEEDERS AND TRANSMISSION LINES. . . . .

INGOTS, SHEETS, WIRE, TUBING, CASTINGS.

Prices with full information on application.

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We manufacture TELEPHONES for all kinds of service ; Central, Exchange, Factory, Warehouse, etc. Our

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as illustrated is a handsome instrument, perfect in construction and design, with no exposed contacts or wires, and has many other points of advantage.

Fully guaranteed and sold on merit.

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Electrical Lighting Supplies

TRANSFORMERS

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The "Type R"

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Durability, Safety and Efficiency.
Built of Best Workmanship.
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Small Temperature Rise.
Good Regulation.

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Have Interchangeable Primaries and Secondaries.

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Is of the Sealed Type.

Is Correct on all loads from two per cent. of its capacity to fifty per cent. overload.

Its Accuracy is Independent of the Character of Load whether Inductive or Non-Inductive.

Dust, Insect, Moisture and Waterproof.

Write Us For Quotations.

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ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

The eleventh annual convention of the Ontario Association of Stationary Engineers was held in Toronto last month. About 70 members were present from Kingston, Ottawa, Bowmanville, Sarnia, London, Brantford, Hamilton and Orillia. Very encouraging reports were submitted by the registrar and treasurer. The election of officers resulted as follows:—President, Chas. Moseley; vice-president, J. G. Bain; treasurer, A. M. Wickens; registrar, W. G. Blackgrove. The next meeting will take place in Brantford.

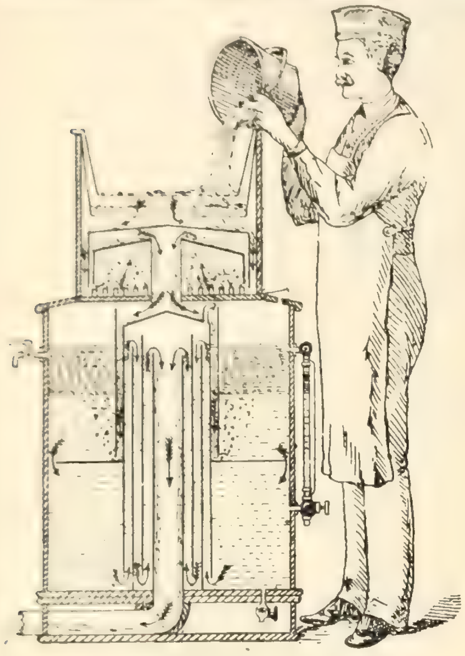

PLATE 2, Sectional View of Filter.

OIL FILTERS

The Dominion Oil Filter and Extractor

Is the only perfectly Automatic Oil Filter and Extractor known. It depends entirely upon natural laws for the performance of its work. No charcoal or other solid filtering material is used. The simplicity of its construction, coupled with the thoroughness of its work, is a marvel to mechanical engineers. Oil that, ordinarily, could be used but once, owing to its dirty and impure condition, is made once again commercially pure, thoroughly free from grit or other contaminating material, and as its lubricating quality has not been impaired it may be used over and over again, thus resulting in an enormous saving in the cost of lubricants.

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By connecting our filter with the drain pipe of your heater you can save 80 per cent. of your cylinder oil.

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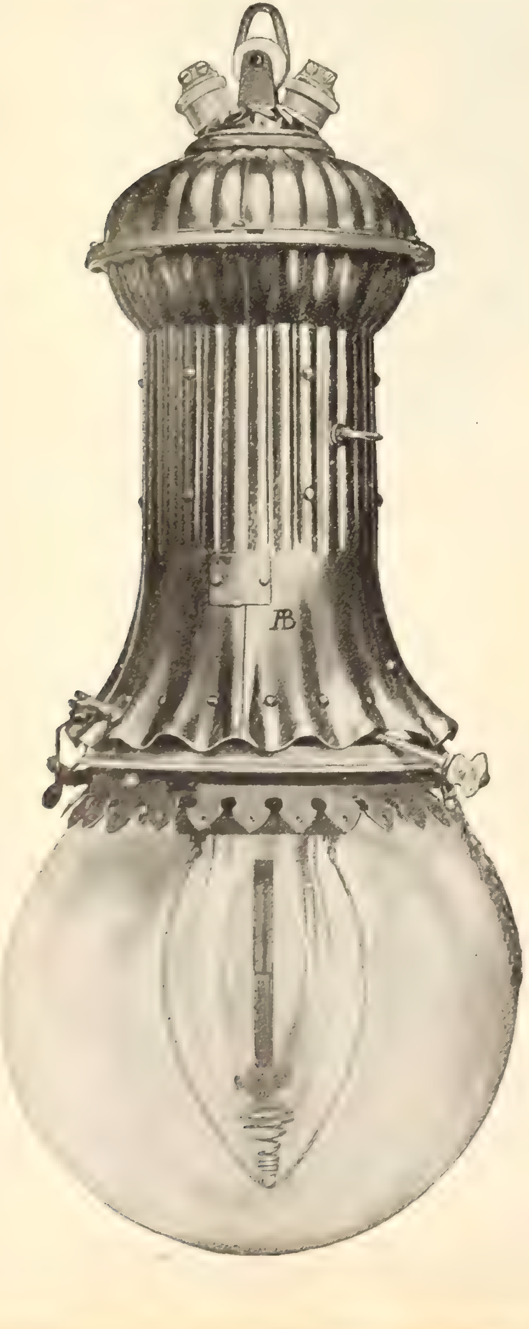

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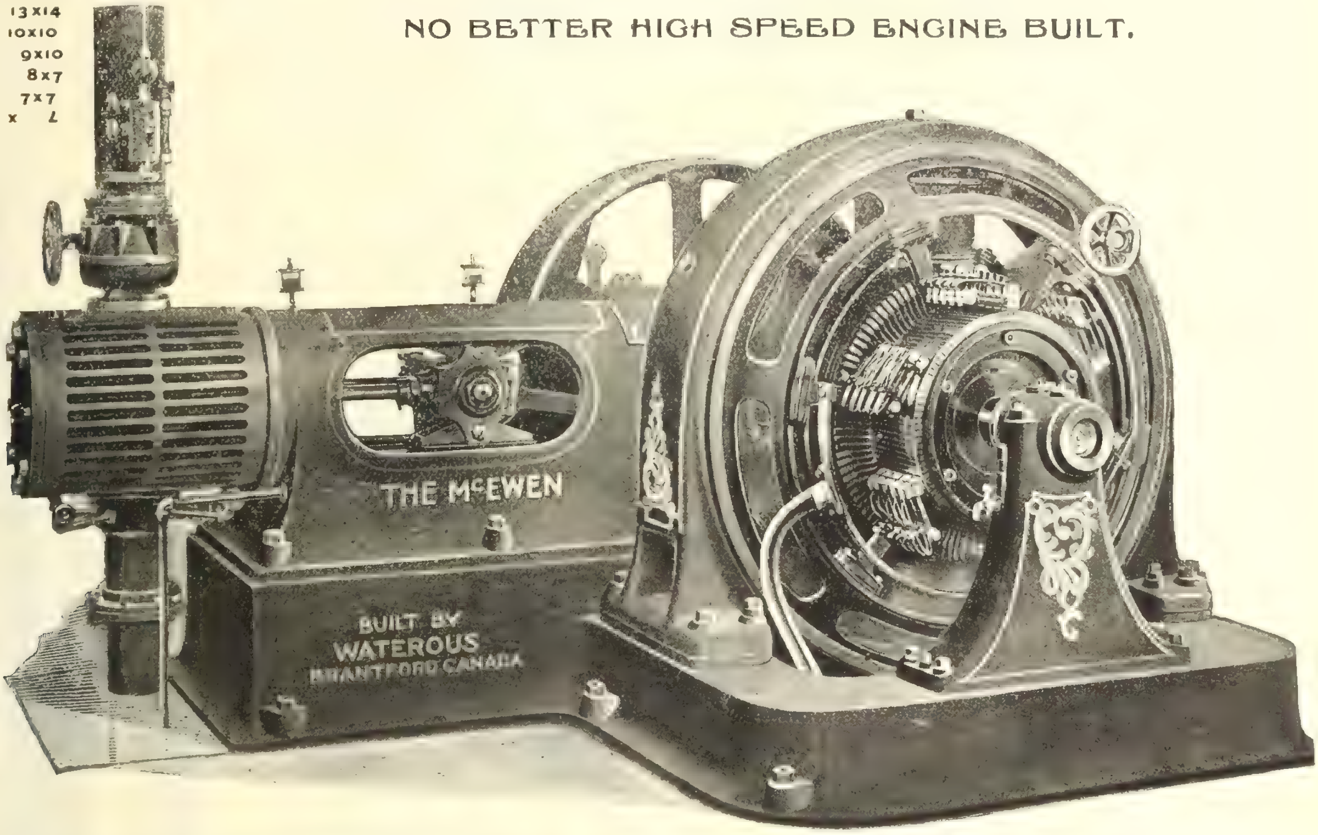

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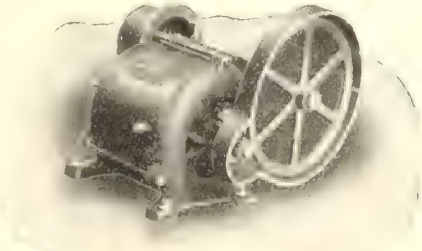

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ANNOUNCEMENT.

Milwaukee, May 16th, 1903.

The constantly increasing demand for Christensen air brakes and "Ceco" electrical machinery has made a change of our organization necessary. To accomplish this result, the owners of the stock of this company have organized the National Electric Company, and the assets, good will, etc., of this company have this day been transferred to the National Electric Company; the purposes, ownership, management and control of the new company are identical with those of the old.

We desire and solicit a continuance under our new name of the satisfactory relations which have heretofore existed between us and the trade.

Yours very truly,
Christensen Engineering Company.

THD "KING EDWARD."

The Consolidated Electric Co., Ltd., whose advertisement of the "King Edward" dynamo and motor appears in this issue, wish to extend their greetings to the members of the Electrical Association as well as the readers of the News. The company solicit an investigation by all those interested in using electrical power. The "King Edward" is giving universal satisfaction. None but skilled workmen are employed at the works of this company, and the very best material enters into all their output.

Perfect mechanical and electrical designs give results which prove the machines to be of the greatest possible efficiency.

Speaking to the manager of this company, he said a burn-out was an unknown thing to them. This speaks well for careful insulation.

The Consolidated Electric Co. would be glad to welcome visiting delegates to the Electrical Convention at their works, 9 and 11 Court street, Toronto.

PACKARD TRANSFORMERS

The cut herewith shows the coils and core of Packard Type "R" transformer before placing in the case.

In point of insulation no transformer yet made surpasses type "R". The insulation is by micanite troughs, owing to its cost a feature heretofore eliminated in transformer construction.

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Announcement

The Canadian Casualty and Boiler Insurance Company, with Head Office at the north-east corner of Adelaide and Victoria Streets, Toronto, has recently been formed, with a subscribed capital of Half a Million Dollars, and has made the necessary Government Deposit to inspect and to insure Steam Boilers.

By insuring your Boilers in the Canadian Casualty and Boiler Insurance Company, you may consult and receive information free of charge upon all questions pertaining to Steam Boilers, Boiler Rooms, Engineers, and Installation of Steam Plant, its care, maintenance and fuel consumption.

Such service as this pays and pays well in the end. May we tell you about our plans and rates?

We will send you, for the asking, our booklet entitled "To Users of Steam Boilers" if you will write us on your business stationery.

We are also duly licensed to transact Elevator Insurance, Sprinkler Leakage and Personal Accident Insurance.

It would pay you to write us for information before placing your business elsewhere.

The Officers of the Canadian Casualty and Boiler Insurance Company are:

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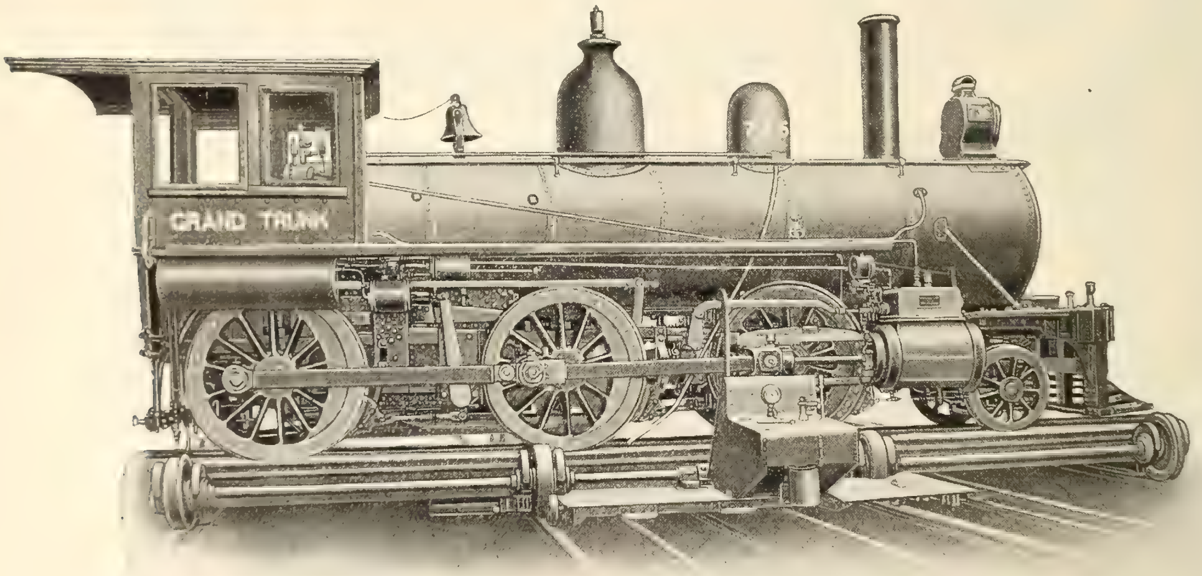
The Bearings are manufactured in Canada. Numerous testimonials might be given of their success. All Bearings guaranteed.



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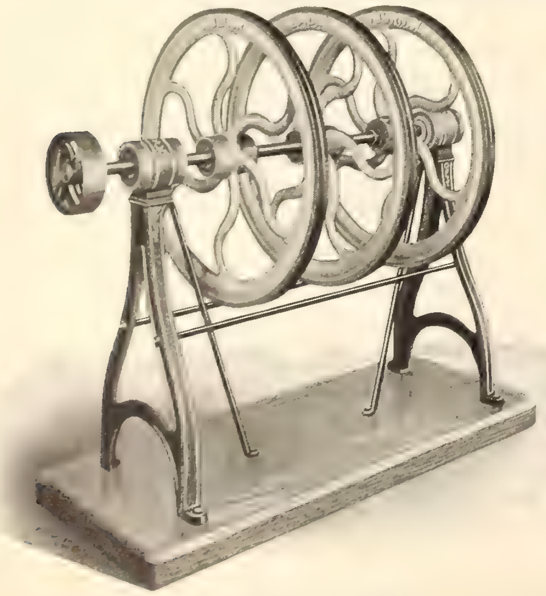

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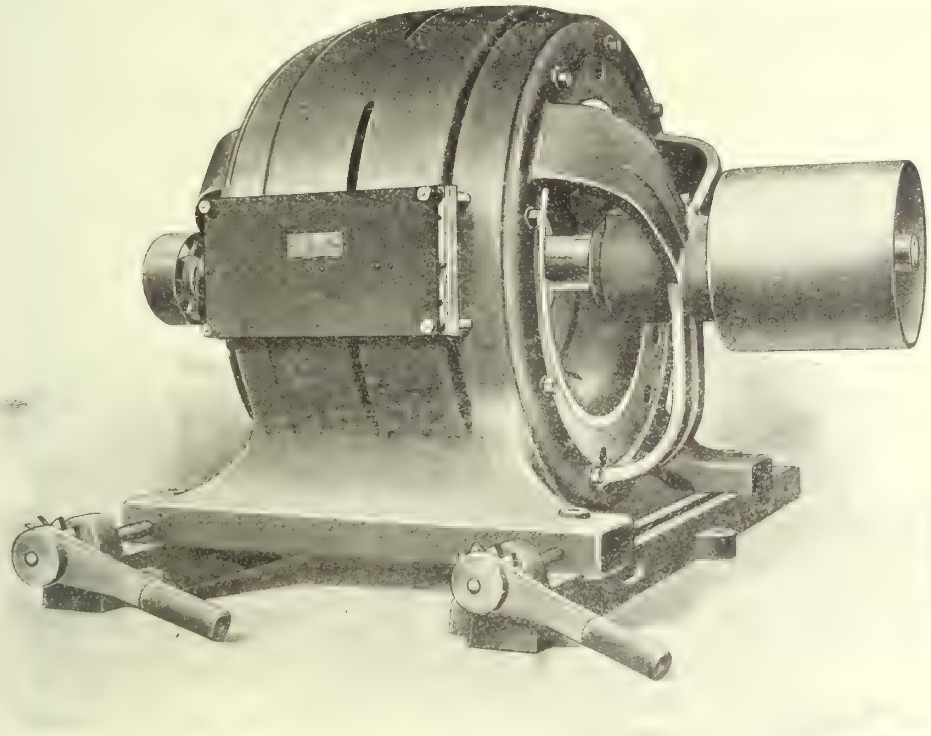

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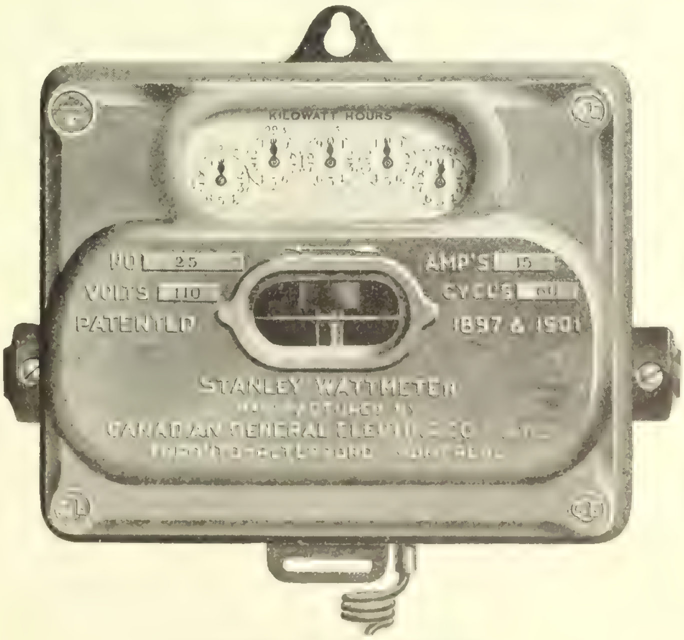

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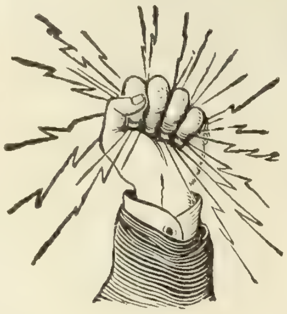

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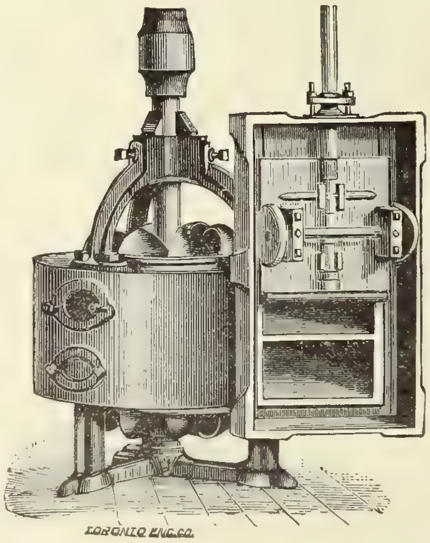
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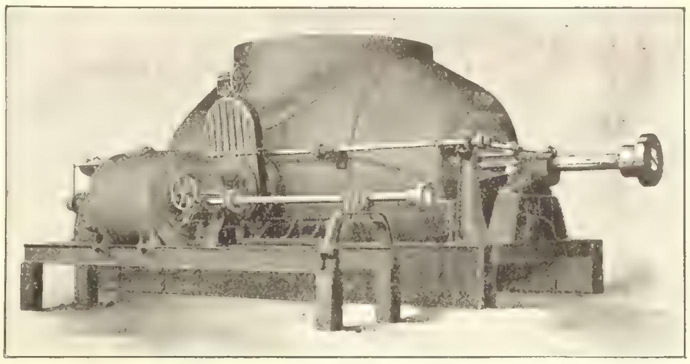
4,000 H. P., 72 ft. head, arranged to drive generator and a single turbine to drive exciter. Five settings built for the Hudson River Water Power Company for their Spier Falls plant and 14 pairs 51 inches for their plant at Mechanicsville, N. Y.



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PERSONAL.

The death occurred last month of Mr. W. L. Waring, inspector of boilers, St. John, N. B.

Many readers of the ELECTRICAL NEWS learned with sincere regret of the recent death of Mr. John McLaren, president of the Canadian Oak Belting Company, of Brockville, Ont.

Prof. Rutherford, of McGill University, Montreal, has recently been honored by election as a Fellow of the Royal Society of London, England. He is the fifth Canadian to be accorded this distinction

Mr. James Ross has resigned as vice-president of the Montreal Street Railway Company and retired from the directorate. He has been succeeded by Mr. F. L. Wanklyn, general manager of the company.

Mr. Duncan McDonald has resigned his position with one of the traction companies at Paris and will become general superintendent of the Montreal Street Railway, a position which he occupied for some time previous to his Parisian appointment. Mr. McDonald's many friends will welcome his return.

Mr. William Burlingham has accepted an appointment as chief engine-designer with the B. F. Sturtevant Company, of Hyde Park, Mass., resigning a position in the United States Inspection Office with the Wm. R. Trigg Company, of Richmond, Virginia. Mr. Burlingham has previously been associated with the Bath Iron Works, the General Electric Company, the Southwark Machine & Foundry Company, and the Newport News Ship-Building & Dry-Dock Company. He has also served on Mr. T. A. Edison's staff at the East Orange Laboratory and is a graduate of the Worcester Polytechnic Institute.

SPARKS.

It is probable that a new generator will be installed in the electric light station at Toronto Island.

The subscribers at Truro, N. S., are fighting an increase in rates proposed by the Truro Telephone Company.

The town council of Almonte, Ont., have engaged an engineer to prepare plans for the development of additional electric power.

The Canadian Northern Railway Company purpose building two new elevators at Port Arthur, Ont., to be operated by electric power.

The Gamewell Fire Alarm Company, of Boston, are about to install a telephone system for the city of St. John, N. B., at a cost of $8,982.

A by-law to purhase the electric light plant at Palmerston, Ont., and operate it under municipal control, was carried by the ratepayers recently.

The new G. T. R. swing bridge over the canal at Burlington Beach, Ont., was opened for the first time on July 2nd. It is 372 long and operated by electricity.

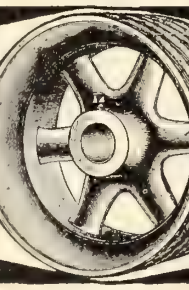
The Cape Breton Coal, Iron & Railway Company, of Sydney, C. B., will build an electric railway from the mines to the docks at Mira Bay, a distance of five miles

The steamer Albuera reached St. John, N. B., last week from Manchester, with 300 tons of rails and fish plates for the St. John Railway Company. These will be used on the proposed extension.

It is proposed to operate the waterworks at Parry Sound, Ont., be electric power, and a by-law will shortly be submitted to the ratepayers to raise funds for the purchase of necessary motors, etc.

The People's Telephone Company of Sherbrooke, Que., have elected the following officers : President, Lieut. Col. Bernard, of Richmond ; Vice-President, C. H. Fletcher, of Sherbrooke ; Secretary Treasurer, T. R. Rider, of Fitch Bay.

The city of Winnipeg is said to have more telephones in proportion to its population than any other city in Canada. The Bell Telephone Company expect that it will be necessary to increase the exchange accommodation within the next two years. Whether this will be done by building an addition to the present building or erecting a new exchange on another site will be decided later. The company intend carrying out considerable underground work in Winnipeg.



Did you Ever See a Dodge Special Dynamo Pulley ?

If not you are behind the times in operating your electric plant and have not seen the best dynamo pulley ever made.

We make these special pulleys double armed, iron center, wood rim split featured, to meet the growing demands of electrical development in the Dominion.

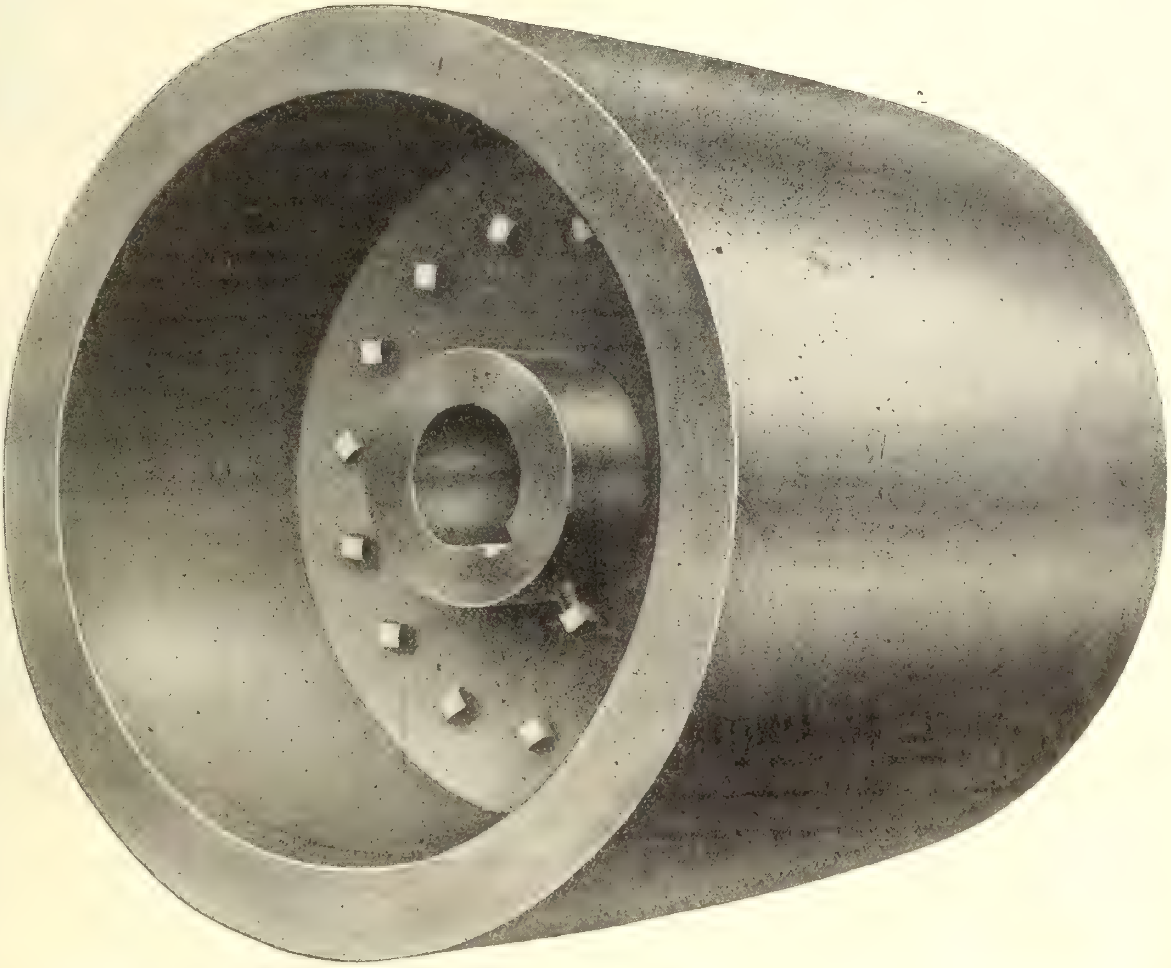
During the past few years we have supplied many of the largest manufacturers of electric generators with these pulleys and in every instance they have given the greatest satisfaction.

Incidentally we make the finest power transmission appliances in Canada.

We'll be pleased to send you a catalogue or to design any special power transmission machinery that may be required by the exigencies of your business.

DODGE MAN'F'G CO. OF TORONTO, LIMITED
TORONTO
ENGINEERS, MACHINISTS, FOUNDERS

XYLOTITE PULLEYS



THE ABOVE PHOTOGRAPH WAS TAKEN FROM ONE OF A LOT OF OUR 52½x56x8 XYLOTITE PULLEYS, WHICH WERE THE LARGEST FIBRE PULLEYS EVER MANUFACTURED.

SPECIFY XYLOTITE PULLEYS ON ALL APPARATUS

WE MAKE ALL SIZES. NONE TOO LARGE OR NONE TOO SMALL.

THE XYLOTITE MFG. CO.

CINCINNATI, OHIO

TELEPHONE JUDGMENT.

The injunction case of the town of Fort William against the Bell Telephone Company, was held recently before Mr. Justice Teetzel at Port Arthur. This case was entered last February by the town. The court ordered that the case be dismissed; "the plaintiffs shall not until judgment has been pronounced by the final appellate court, to which the action of the corporation of the city of Toronto against the Bell Telephone Company of Canada, Limited, now pending, may be carried; or such action shall otherwise be disposed of, bring action or take any proceedings to interfere with the erection of poles or the stringing of wires by the defendants in the said town, or the erection or use of any other appliances permitted by their charter and necessary or convenient for carrying on business of defendants in the said town." The court ordered that the plaintiffs pay the defendants one dollar damages for loss sustained by reason of the injunction orders granted; and also pay to the defendants their cost of this action, including the costs of Feb. 17th, 1903, and Feb. 19th, 1903, and of the motion and order permitting the defendants to deliver their statement of defence, June 19th, 1903, as between solicitor and client forthwith after taxation.

PUBLICATIONS.

The Alternate Current Transformer, by F. G. Baun, of Stamford University, Cal.; This book originated from a course of university lectures. It comprises ten chapters, the first two being merely introductory, while chapters 3 to 5 are designed to give the student a thorough knowledge of the transformer. In chapter 6 are outlined tests which should be carried out by the student on a few commercial types. Chapter 7 offers a method of design which is considered an improvement over that which is usually given in text books. Altogether, it is a very valuable work. The publishers are the McGraw Publishing Company, of 114 Liberty Street, New York, and the retail price is $1.50.

Electrical Engineering, by E. Rosenberg: This is an elementary text book suitable for persons employed in the mechanical and electrical engineering trade and for elementary students of electrical engineering. The aim of the author has been to use such language that people who have only a general school education would understand. It covers the fundamental phenomena of the electric current, dynamos and motors for continuous, alternating and three-phase current, accumulators and their apparatus, measuring instruments, and electric lighting. John Wiley & Sons, 43 East 19th Street, New York, are the publishers.

The McGraw Publishing Company, 114 Liberty street, New York, have just issued volumes 1, 2 and 3 of Abbott's "Telephony." The entire set will consist of six volumes, the other three volumes to be issued later. The price is $1.50 per volume if sold in single volume, or $6 for the entire set if ordered at one time. Volume No. 1 deals with the location of the central office; volume 2 with the installation of conduits which are usually employed in the larger cities, including data of the cost of various forms of conduits; while volume 3 deals with the manufacture and installation of modern forms of telephone cables and is a brief exposition of the principles which telephonic laws obey, closing with a chapter on the cost of cable plant.

The Woodstock, Ont., Water & Light Department, have taken tenders on extensions to the electric plant, including one 150 horse power boiler, one 200 horse power high speed engine, and one 120 k. w. 125 cycle single-phase alterating generator.

The most serious accident in the history of the Hamilton, Grimsby & Beamsville Electric Railway occurred on June 25th, when Conductor Braidwood was killed and several passengers were injured. A head-on collision occurred near Winona, between the regular passenger car and a special freight car. It is understood that the accident was due to a confusion of orders.

Direct Connected Generators
For Railway, Lighting and Power

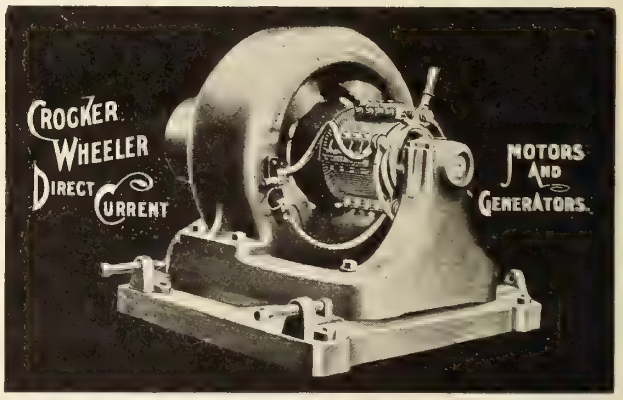
Belt Driven Generators

Multi Voltage System
For Variable Speed Control.

Crane Motors and Controllers

WRITE FOR BULLETINS

THE R. E. T. PRINGLE CO., LIMITED
St. John, N. B. Montreal Toronto

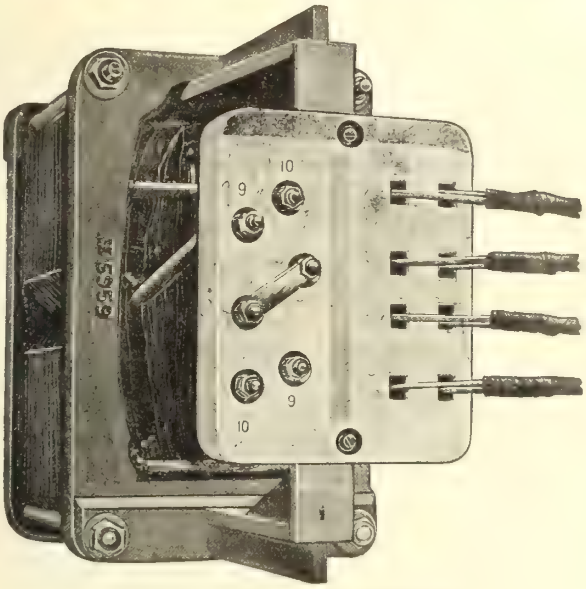


Pitsburgh
Transformers.

An unnecessary expense is a luxury. Transformer troubles and expense are pretty much the same thing, and what is more are a luxury that you can well afford to do without. Use Pittsburgh transformers and save a lot of trouble.

The R. E. T. Pringle Company, Limited, **Sales Agents**

Westinghouse
Type N and O D Transformers



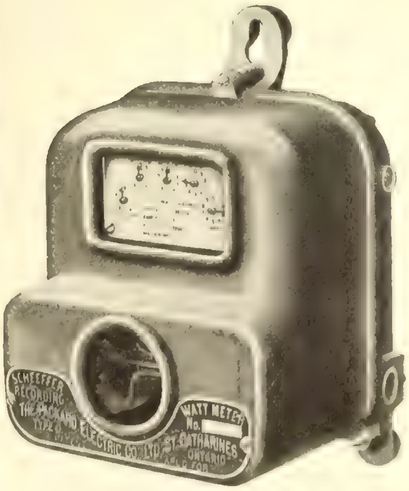
Terminal Block of Transformer.

Two primary and nine secondary voltages permit the same transformer to cover a wide range of working conditions. No central station manager can afford to purchase transformers having but two secondary voltages, when a choice of nine may be had from a Westinghouse Type N or O D Transformer.

Write for Transformer Publication 7007.

Ahearn & Soper Limited
Ottawa, Canada.

Packard Type "G" Recording Watt Meter



No watt meter yet presented to central station managers in the Dominion has given the unqualified satisfaction as has type "G".

It is the one meter sold which is absolutely fair to both consumer and central station.

It is the most sensitive meter sold and every station manager is assured in its use that it will record all current consumed but no more.

Type "G" is so sensitive that it will measure the energy of a Hylo lamp burning on its baby filament.

Let us tell you more about it.

The Packard Electric Co., Limited
St. Catharines **Montreal**
Lamps, Meters, Transformers, Hylo Lamps,

American Circular Loom Company's FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

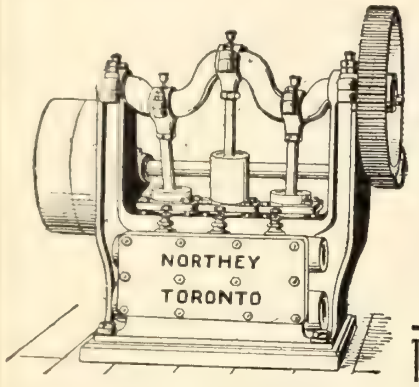
MONTREAL ELECTRIC COMPANY, AGENTS.

The ORIGINAL and only GENUINE "Circular Loom." Has been in the market for twelve years, and handled by us for over nine years. No other substitute has ever taken its place for quality and adaptability. For price lists, discounts and full information, address

Montreal Electric Company, 354 St. James Street, **Montreal**

Instant shipments made. Large stock of all sizes always on hand.

THE NORTHEY TRIPLEX POWER PUMP



This pump excels in high class materials and workmanship. A practically constant delivery is assured by the three cranks being placed 120 degrees apart. The pump can be operated conveniently by water power—by belt from engine or by electricity.

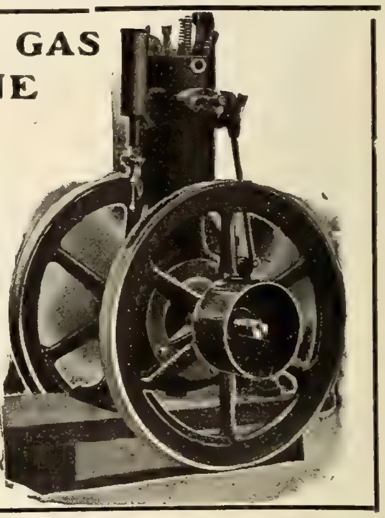
We manufacture pumps of every description—for all purposes. Our pumps are standard in Canada for excellent service.

Write for Catalogues.

The NORTHEY GAS AND GASOLINE ENGINE

The Northey Gasoline Engine offers the best proposition in the market for cheap, easily handled power. The Engine runs with practically no attention—any boy can manage it—running expenses very light. Ready for work on the minute. Suitable for running independent electric light plants—pumping and elevator plants, etc. This cut illustrates the ½ H. P. size—the only vertical style built; all other sizes are horizontal.

Write for Booklet.



THE NORTHEY CO., LIMITED, 970 King Street Subway **TORONTO.**

New Helios-Upton Arc Lamps

HAVE

- Simplicity of mechanism.
- Every portion easily accessible by removing outside case.
- Upper carbon holder has an outside cable connection.
- Large inner globe supported from the bottom.
- Porcelain lined inner globe cap.
- Most durable form of resistance.
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- Easily adjusted.
- Steady burner.

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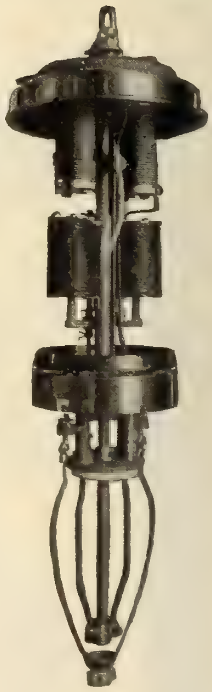
708-710 Craig Street, Montreal



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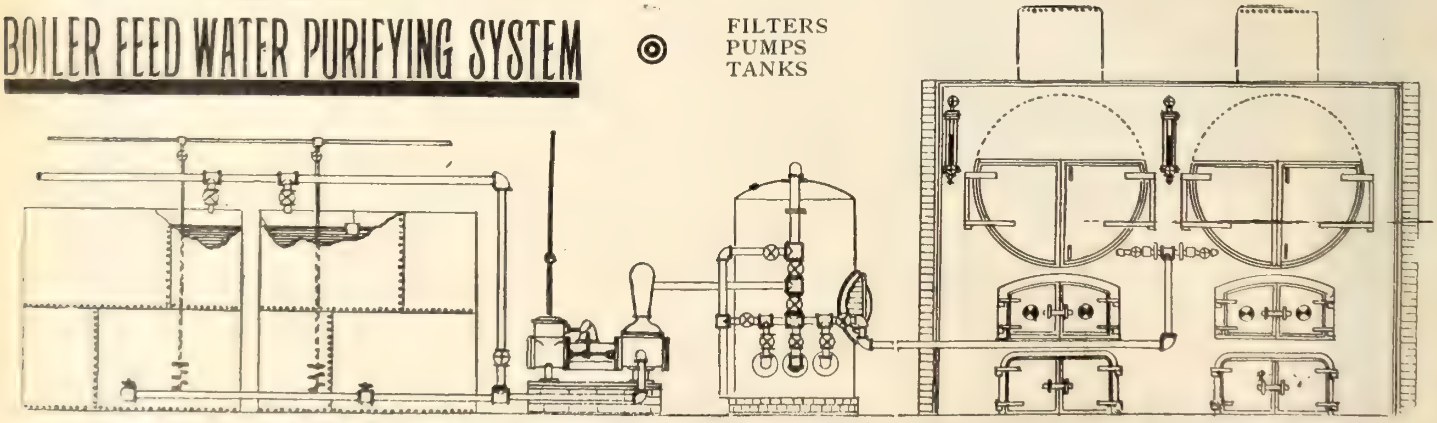
PUMPS
TANKS



THE JOHN McDOUGALL CALEDONIAN IRON WORKS, LIMITED, - - Montreal, Que.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. JULY, 1903 No. 7.

OTTAWA ELECTRIC COMPANY.

Then annual meeting of the Ottawa Electric Company was held a fortnight ago. The report submitted showed that the gross revenue from all sources for the year was $217,386.83, and the expenses of operating and maintenance $118,890.44, leaving a gross profit for the year of $98,496.39. The gross revenue as compared with the previous year decreased $10,248,00 due to a reduction of 20 per cent. in the charges for lighting which came into effect on November 1st, 1902, and a further reduction of 20 per cent. which took effect February 1st, last. The sum of $58,541.95 was expended upon capital account during the year for the new power house switch-board, extension of pole lines and circuits, etc.

The statistical statement contained the following information: The increase in the number of customers for the year was 321, the figures standing: 1902, 5,820; 1903, 6,141. In the number of incandescent lights installed there was an increase of 9,926, the figures reading: 1902, 104,407; 1903, 114,133. In 1903 there were 887 arc lamps as against 752 for the previous year, an increase of 135. Heaters showed an increase of six, there being 30 in 1903 as against 24 in 1902. Motors showed a similar increase in numbers, there being 163 in 1903 as against 157 in 1902. In the last nine years there has been an increase of 3,421 in the number of the company's customers, in fact the number has been doubled.

Directors were elected, and at a subsequent meeting of the directors the following officers were chosen: President, T. Ahearn; Vice-President, F. P. Brompton.

The C. E. A. Convention Group at the Canada Foundry Company's. Works.

THE CANADIAN ELECTRIC LIGHT COMPANY.

The annual report of the Canadian Electric Light Company, of Quebec, Que., presented at the annual meeting in that city on June 23rd states that on the 1st of May, 1902, they had in operation 5,777 electric lamps, and, on the 30th of April, this year, they had 11,484, that is, 4,410 more than during the last year, which is equivalent to an increase of 62 per cent. On the 30th of April, 1902, they supplied 72 electric horsepowers, as motive power. Oh the 30th of April, this year, they supplied 276, which represents an increase of 362 per cent.

The company are now supplying power for the operation of the Levis County Electric Railway, the construction of which is largely due to the president, Mr. G. U. G. Holman.

The report further states that the company have laid a second cable across the river. It is placed far enough from the first cable that the two will not be exposed to the same risks and the same inconveniences. The new installation at Chaudiere Falls, including new turbines and dynamos, is expected to be completed in September.

For the twelve months ending April 30th, 1903, the earnings of the company were $35,459.54, an increase of $15,915.27. The new plant will increase the productive power by about 66 per cent.

The town council of Fort William, Ont., have appointed a committee to act with an engineer in ascertaining the cost of developing 2,000 horse power of electrical energy at Ecarte Rapids.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

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Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.

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Imperial Building, Montreal.
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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Door Keeper N. BEAN, -	Waterloo, Ont

The Canadian Electrical Association. The Thirteenth Annual Convention held in Toronto last month marked another distinct advance in the history of the Association which has made steady and substantial progress since its organization. Starting with a membership of about twenty-five it has grown to be a strong and influential organization with nearly four hundred members representing electrical interests in every part of Canada, with a fair sprinkling from the United States.

The recent convention brought together an attendance of nearly two hundred, and included members from such distant points as Halifax, the Northwest Territories, St. Louis and Cincinnati. A gratifying feature was the large and constant attendance of members at the business sessions, and their close attention to the papers and discussions. This may be taken as proof of a desire to profit by the information supplied at these meetings by experts and men of wide experience in the electrical field. The papers were of a very interesting and instructive character. The only cause of objection in this connection would seem to be the relatively small proportion of papers of late by Canadian authors. Canadians should come more prominently to the front in the preparation of papers for future conventions. There undoubtedly are a number of men identified with the electrical interests of Canada who have not yet been heard from, whose experience, if put on paper, would benefit the Association and the electrical fraternity at large. It is to be hoped the Committee on Papers for the present year may be able to discover some of these men and bring them to the front.

The Question Box, which of late has become so popular and valuable a feature of the National Electric Light Association of the United States, was introduced at the C. E. A. convention this year, and met with instant favor. Unfortunately but little time could be given to it, as the programme was practically completed before it occurred to some of the members to suggest the adoption of the idea. The Executive has been asked to appoint an editor for the Question Box and an appropriation has been made to cover the cost of the necessary correspondence. If every member will make a point of submitting one or more questions or answers during the year, a fund of information of the greatest value will be secured and made available for use. As time goes on other means will no doubt be found of increasing still further the benefits conferred by the Association upon its members.

The Local Committee received well merited praise for the carefull planned and executed programme of entertainment provided for the visitors. No hitch of any kind occurred, and so far as could be learned everybody had a good time.

The election to the Presidency of Mr. J. J. Wright, first President of the Association, who was prevented by serious illness from attending the convention, was a graceful recognition of that gentleman's unwavering interest in and valuable services to the Association from the days of its infancy until the present. With the loyal support of a capable Executive, the continued progress of the Association in numbers and usefulness may confidently be predicted, and a successful meeting in Hamilton next year anticipated.

Canadian Electrical Association

Proceedings of the Thirteenth Annual Convention

THE thirteenth annual Convention of the Canadian Electrical Association was held in the Assembly Hall of the King Edward Hotel, in the City of Toronto, Ontario, on Wednesday, Thursday and Friday, June 10th, 11th, and 12th, 1903.

At 11 o'clock a.m. on Wednesday the President, Mr. B. F. Reesor, of Lindsay, took the chair, and called the Convention to order.

The following persons were registered as being in attendance :

A

C. H. Abbott, St. John, N.B., R. E. T. Pringle Co.
J. G. Archibald, Woodstock, Ont., Corporation Lighting System.
J. J. Ashworth, Toronto, Canada Foundry Co.
Geo. Angus, Toronto, C. E. A. Official Stenographer.
K. T. Aitken, Toronto, C. G. E. Co.
Jas. Anderson, Windsor, Ont.

B

Frank G. Bolles, Cincinnati, Bullock Electric Mfg. Co.
J. A. Burns, Montreal, Munderloh & Co.
Wm. A. Bucke, Toronto, C. G. E. Co.
A. T. Beecroft, Corporation of Barrie, Ont.
F. Jno. Bell, Montreal, C. G. E. Co.
R. G. Black, Toronto Electric Light Co.
A. E. Brock, Toronto, National Electric Co., Ltd.
H. D. Bayne, Montreal, Westinghouse Co.
C. W. Bongard, Manufacturers Agent, Toronto.
J. E. Bilger, Toronto, Berlin Gas Co.
Jas. Bannon, Toronto, Chief Engineer City Hall.
E. B. Biggar, Toronto.
Wm. B. Boyd, Sydney, C. B., Dominion Iron & Steel Co.
W. A. Boys, Barrie, Ont.
J. H. Bennett, Municipal Electric Plant, Barrie.
W. M. Beall, Toronto, Consolidated Electric Co.
L. J. Belnop, Montreal, Bullock Electric Mfg. Co.
Henry P. Beaupre, Montreal, Westinghouse Co.
W. H. Breithaupt, Berlin, Ont.
J. F. Birchard, Detroit, Wing's Graphite Co.

C

J. W. Campbell, Toronto, C. G. E. Co.
V. B. Coleman, Port Hope Electric Light & Power Co.
Alfred Collyer, Montreal, Bullock Electric Co.
Geo. A. Childs, Montreal, American Steel & Wire Co.
R. E. Campbell, Toronto Metaphone Co.
P. S. Coate, Chatham, Ont., Gas Co.
C. E. A. Carr, Manager Elec. Street Railway Co., London, Ont.

D

A. A. Dion, Superintendent Ottawa Electric Co.
W. F. Dean, Toronto, C. G. E. Co.
Alfred Demers, St. Cesaire, Que., C. G. E. Co.
J. M. Dobbie, of A. G. Dobbie & Co., Brockville.
A. T. Duncan, St. Catharines, Manager Lincoln Electric Light & Power Co.
J. M. Deagle, Cataract, Ont.
J. Deagle, Jr., " "
L. Denis, Quebec, Jacques-Cartier Electric Co.
Hy. Stansfield Dodd, United Electric Co., Toronto.
F. F. Dryden, Toronto, Westinghouse Co.
Cecil Doutre, Montreal, John Forman Co.

E

H. O. Edwards, Toronto, C. G. E. Co.
A. Esling, Toronto, R. E. T. Pringle Co.
Ed. A. Evans, Manager Quebec Railway, Light & Power Co.
W. D. Earngey, Toronto, Secretary Hooper Magnetic Electric Brake Co.
E. S. Edmondson, President Oshawa Electric Light Co.
H. C. Ebert, Pittsburg, Pa., Westinghouse Co.

F

H. O. Fisk, Peterboro Light & Power Co.
Chas. L. Farrer, Lakefield, Ont., Electric Light Co.
T. C. Frenyear, Buffalo, Westinghouse Co.
J. W. Farley, Pittsburg, " "
C. E. Fortier, Toronto.

G

John Galt, C. E., Toronto.
G. Groves, Corporation of Parry Sound.
P. G. Gossler, Gen. Supt. Montreal Light, Heat & Power Co.
J. C. Grant, Toronto, B. F. Sturtevant Co.

H

Ormond Higman, Ottawa, Chief Electrical Inspection Dep.
Chas. B. Hunt, London, Ont., Electric Co.
A. T. Hicks, Trenton Electric & Water Co.
P. H. Hover, New York Insulated Wire Co., N. Y.
C. W. Henderson, Montreal, Westinghouse Electric Co
Gordon J. Henderson, Supt. Hamilton Electric Light & Cataract Power Co.
J. Herbert Hall, Toronto, Richmondt Conduit & Mfg. Co., Ltd
Thos. Hilliard, Ottawa, C. G. E. Co.
J. G. Howorth, Toronto, Manager Consolidated Electric Co., Ltd.
J. R. Hooper, Toronto, Travelling Representative Canadian Electrical News.
Geo. F Haworth, Toronto, Sadler & Haworth.
R. B. Hamilton, St. Catharines, Packard Electric Co., Ltd.
Chas. H. Hines, A. I. E. E., Montreal, Electrical Engineer Canadian Pacific Railway Co.
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R. J. Henderson, Toronto, Henderson Roller Bearing Co

I

E. Irving, Toronto, The Sunbeam Incandescent Lamp Co

J

E. J. Jenking, Toronto, C. G. E. Co.
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H. Jecks, Toronto, C. G. E. Co.

K

H. B. Kirkland, Chelsea, Mass., American Circular Loom Co Boston.
Jos. Knox, Manager Stayner Electric Light Co.
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Jas. Kynoch, Toronto, C. G. E. Co.
E. H. Keating, Manager Toronto Street Railway.

L

J. M. Leamy, Buffalo, Westinghouse Co.
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F. Lyonde, Toronto.
Robt. T. Lozier, Cincinnati, Gen. Manager Bullock Co.
J. D. Lawson, St. Louis, Mo., Dean of the Missouri Law School.

M

C. H. Mortimer, Toronto, Secretary-Treasurer Canadian Electrical Association.
H. A. Moore, Toronto, Canadian Bullock Electric Co.
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F. W. Martin, St. Catharines, The Martin Electric Supply [illegible]
A. P. Manning, New York, Cutler Hammer Mfg. Co.
G. C. Mooring, Toronto, Chief Engineer Methodist Book [illegible]
J. W. Moyes, Manager Metropolitan Electric Railway, Toronto
W. R. J. Macpherson, Peterboro, Ont.
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W. H. Meldrum, Peterboro, Otonabee Power Co.

Mc

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Wm. McCaffrey, Toronto, C. G. E. Co.
J. K. McDonough, Toronto, C. G. E. Co.
W. McLeish, Toronto, Monetary Times.
J. M. McLennan, Lindsay, President Light, Heat & Power Co

N

F. Nicholls, Jr., Toronto.
G. B. Nicholson, Toronto, C. G. E. Co.
H. G. Nicholls, Toronto, C. G. E. Co.

O

Dr. [illegible] Montreal, [illegible] University.
Geo. [illegible] Montreal, [illegible]

P

J. W. [illegible], Walkerville, Chief Electrician Hiram Walker & Sons.
J. W. Pilcher, Halifax, N. S., C. G. E. Co.
E. B. Price, Toronto, C. G. E. Co.
[illegible] Parke, Toronto, Consulting Electrical Engineer.
Edwin Pope, Quebec, G. N. W. Telegraph Co.
E. G. Patterson, Peterboro, C. G. E. Co.
[illegible] W. Pratt, Brantford Electric & Operating Co.
[illegible] A. Paterson, Brandon, Man., Electric Light Co.

R

B. F. Reesor, Lindsay, Manager Electric Light, Heat & Power Co.
Jos. Rogers, Toronto, Rogers Electric Co.
C. E. Reid, Toronto, Rogers Electric Co.
L. H. Reesor, Corporation of St. Mary's, Ont.
F. Rose, Toronto, C. G. E. Co.
Geo. C. Rough, Montreal, The Packard Electric Co.
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R. J. Russell, St. Louis, Mo., Wagner Electric Mfg. Co.
A. C. Read, Levis, Que., Canadian Electric Light Co.
W. G. Richards, Chatham, Ont., Gas Co.
W. H. Reynolds, Montreal.

S

C. C. Starr, Halifax, John Starr, Son & Co.
R. M. Saxby, C. E., Manager Bowmanville Electric Light Co.
A. Sangster, Sherbrooke, Que., Manager Power, Light & Heat Co.
A. B. Smith, Toronto, Superintendent G. N. W. Telegraph Co.
W. F. Simmons, Kingston Light, Heat & Power Co.
A. W. Smith, Toronto.
Alex. H. Skene, Bracebridge, Ont,
E. A. Smith, Toronto, Consolidated Electric Co.
Chas. F. Scott, Pittsburg, Pa., President American Institute of Electrical Engineers.
Irving Smith, Montreal, The R. E. T. Pringle Co.
R. A. Stinson, Toronto, C. G. E. Co.
Edward Sise, Montreal, The Wire & Cable Co.
D. M. Stewart, Montreal, General Manager The Sovereign Bank of Canada.
J. E. Skidmore, Cobourg Water & Electric Co.
Warren Y. Soper, Ottawa, Ahearn & Soper Ltd.
Thos. Stewart, Lindsav, Light, Heat & Power Co.
Alex. Smith, Toronto Street Railway Co.
J. E. Stephenson, Montreal, J. C. McLaren Co.
J. Sangster, St. Catharines, Ont., Superintendent Power House Cataract Power Co.
P. J. Sanderson, Orillia, Ont., Municipal Light & Power Plant.
E. T. Silton, London Electrical Construction Co.
L. Sangity, Hamilton, Superintendent Power House Cataract Light & Power Traction Co.
Alderman Starr, Acting-Mayor, Representing Corporation of Toronto.
A. Storer, Toronto, Chief Electrical Engineer King Edward Hotel.

T

Fred Thomson, Montreal, F. Thomson & Co.
J. P. Thomson, Montreal, E. F. Phillips Electrical Works Ltd.
G. S. Thomson, New York City, The Adams-Bagnall Electric Co.
Max Toltz, Montreal, Consulting Electrician C. P. R. Co.
J. Fredrick Thorne, Pittsburg, Pa., Westinghouse Co.
Clarence Thomson, Montreal, F. Thomson & Co.

W

A. A. Wright, M. P., Renfrew, President Electric Light & Power Co.
G. M. Wright, Montreal, R. E. T. Pringle Co.
A. E. Wilson, Toronto, C. G. E. Co.
Chas. Wilkinson, Brockville Light & Power Department.
W. H. Wiggs, Quebec City, Mechanics Supply Co.
Wm. Wilds, Sarnia Street Railway Co.
Wm. Williams, Manager Sarnia Gas & Electric Light Co.
J. A. Whyte, Toronto, Assistant Inspector Gas & Electric Light.
Geo. W. Watts, Toronto, Assistant-Manager C. G. E. Co.
F. C. Whatmough, Stratford, Ont., Electrical Contractor.
R. R. Wiley, St. Catharines, Packard Electric Co.
W. Warren, Toronto, C. G. E. Co.
C. W. Watson, Orangeville, Ont.
W. D. Wilgar, Toronto, C. G. E. Co.
G. E. Woodhouse, Toronto Metaphone Co.
E. Ward Wilkins, Philadelphia, Pa., Partick, Carter & Wilkins.
C. D. Warren, Toronto, President Metropolitan Electric Railway.
Arthur Warren, New York, Westinghouse Co.
A. M. Wickens, Toronto, Inspector Canadian Casualty & Boiler Insurance Co.
Alderman Ward, Toronto.

Y

John Yule, Manager Guelph Light & Power Co.

The President called upon Ald. Starr, who, in the absence of His Worship Mayor Urquhart at Ottawa, was acting Mayor, and Ald. Ward, Chairman of the Civic Reception Committee, to address the Convention.

Ald. Starr : Mr. President and Gentlemen: On behalf of the Corporation of the City of Toronto I desire to extend a very hearty welcome to the Canadian Electrical Association. I do not suppose that we have had meeting within the borders of our city a more important association than the one which is now before me. I notice by your programme that the citizens of Toronto ought to be deeply interested in some of your deliberations. I see one of your members is to read a paper on "Long Distance Transmission." The City of Toronto is struggling, perhaps from another standpoint, with the same question of long distance transmission. We think if we can get power cheap enough from Niagara Falls we can make out of this City of Toronto, beautiful as it is now, a great industrial manufacturing centre, because of cheap power that will come to us. It may be that we cannot follow the technicalities of a scientific paper on the question, but we can follow the economical problem. I would suggest that you add to that paper another paper entitled : "How the City of Toronto can get cheap power in competition with the companies that have already got the control of the power over at Niagara Falls." If any citizen or any one of your members could help the City of Toronto out on such a problem as that I am sure the City of Toronto would vote not only to give him the freedom of the City of Toronto, but I think we could strain the point and give the freedom of the city to all the members of the Association. (Laughter). Unfortunately, however, I fancy that will lie beyond your ken, and if I would make a guess I would say that probably some of you might be on the other side of the fence on that proposition. We will struggle with it, however, and if we are right we may believe it will come out alright in the long run. I congratulate you, Sir, on the nature of your programme. As far as I can gather from it, it seems to me you have introduced what is called the Question Box, and I know of no greater or better means of information both for discussion and for the acquirement of knowledge than the Question Box. I have had occasion to use it in more ways than one during an experience with conventions, and I find it a most valuable aid to the ordinary humble follower of the usual convention. I do not wish, however, to take up any further time. We think to-day we welcome you to the best hotel on the Continent ; we think to-day we welcome you to the most beautiful city on the Continent ; we think it is clean, if I may say, physically, and we think it is clean morally in a fair comparison with any other city to which we apply it. I have been in my limited experience as far as Chicago, any way, and I think we will compare favorably with the City of Chicago in cleanliness in every way, that is without desiring to reflect at all on Chicago; it is only a comparison. But, feel free to look around for yourselves and see what we have. I am sure that some of you will think that you ought to return and live with us, for we will be able to help you in the day to come. (Applause).

Ald. Ward : Mr. President and Members of the Canadian Electrical Association : I had no idea I was going to be called upon to speak after acting Mayor Starr ; I thought he had covered the ground. However, as Chairman of the Civic Reception Committee, I wish to add a few words of welcome to your delegates while in the city and I hope that you will have a pleasant time while amongst us and carry away pleasant recollections of your visit to the city of Toronto. I hope, Sir, that your deliberations while in session will be of material benefit to your wide-growing institution. I recognize the Canadian Electrical Association as one of the most important in this country, and I am sure that much good will be wrought from your work during the next few days. I hope while in the city you will have an opportunity of visiting our magnificent city hall and viewing our other public buildings. Your local Entertainment Committee have provided a very nice social programme for your entertainment, and I am sure that you will go away with pleasant recollections of your visit. I thank you for calling upon me. (Applause.)

The President : Mr. Dion, of Ottawa, will reply to the address of welcome.

Mr. Dion : Mr. Chairman, I am called on very short notice to reply to the eloquent addresses we have just heard. I do not know that I can do justice to the subject, but I feel that it will be sufficient to express to the acting Mayor and Ald. Ward our warm thanks for their kindness in coming here this morning, for the very nice things they have said about us, and for tendering us the hospitality of this beautiful city. We feel very grateful to them and the citizens of Toronto. We are glad to meet in this beautiful and interesting city of Toronto and we know that our stay here will be quite as profitable and pleasant as I am sure they wish it to be. With regard to the suggestion thrown out by the Acting Mayor that we should find means of introducing into Toronto cheap power in competition with the existing companies, I have to say, speaking for myself, that I am not in that business. Other members may say what they think about it. (Applause.)

The President then delivered the annual address, as follows :

PRESIDENT'S ADDRESS.

To the Members of the Canadian Electrical Association :

GENTLEMEN,—It affords me a great deal of pleasure to extend to you all a most hearty greeting at this the opening of the thirteenth convention of the Association in the City of Toronto. I must congratulate you that our meeting this year is under such favorable circumstances ; this City is centrally situated and of easy access from every direction. The officers and executive of the Association have been looking forward to a large attendance and a most profitable meeting.

There have been prepared for us by members of the Association and others a number of valuable papers which will be read in due course, and I bespeak for them your most careful consideration and I trust you will follow the reading of them with a free and thorough discussion, so that the salient points in each may be brought out or criticized, and in this way the members present may get the benefit of the knowledge imparted to the fullest degree.

This year a new feature, at least to this Association, has been inaugurated in the establishing of a question drawer, from which I am confident, if properly followed up, much benefit will accrue.

The National Electric Light Association has been working along these lines for some time with unqualified success. In this connection I would suggest that when electing our officers for the ensuing year a "Question Box Editor" be named whose special duty it will be to look after this matter and receive from members of this Association and others, questions that may be pertinent to the interests of light and power companies and those interested in electricity generally.

During the year that is past the question of long distance power transmission has engrossed the minds of capitalists to a greater degree perhaps than at any previous period in the history of this country. Rapid strides have been made in development in this direction and at the present time some very extensive plants are contemplated and under construction, notably around the Niagara Peninsula, and when completed Canada can boast of having some of the largest and best equipped electrical installations in the world.

The successful transmission of wireless messages across the ocean has also been accomplished since our last meeting. Truly electricity has passed its "infancy" stage; let the use of electricity be suspended for one day, yes even for one hour, and our whole commercial, if not our domestic system would be paralyzed.

I trust you are not losing sight of the fact that the tide of municipal ownership is in full flow ; while at this juncture I have not the time, nor the inclination, to discuss the merits or demerits of the movement. I may say, however, in passing that frequently we learn of individuals and municipal councils with whom it has become, to say the least, considerable of a craze, or in other words a case of "municipalities gone mad," but during all this turmoil of unrest we must not forget that vested interests are at stake and must be looked after. Millions of money have been invested in this country by individuals and companies in lighting and power development, sanctioned, and in many intances induced, by the very municipal corporationsthat are now clamoring after or looking with longing and covetous eyes at a business that has been carried from an experimental stage until it has become to all appearances a factor of considerable importance in our every day commercial life.

While the interests above referred to have been most faithfully and I may be permitted to say, most successfully, looked after by your committee appointed for that purpose by this Association, at the same time we feel that the support (financial and otherwise) due this committee by the rank and file of those most vitally interested in the matter has been most lamentably neglected. Why any man or company of men who may have their money invested in lighting or power plants cannot see their way clear to become members of the Canadian Electrical Association is beyond my comprehension. The lessons and experience of the past few years since municipal corporations have been going into the commercial lighting business, should be an incentive for everybody interested in electricity to join this Association and bear their quota of the burden, at least in proportion to the benefit that must necessarily result from the efforts the Association exerts in their behalf. I am glad to say the membership during the past year has been steadily increasing, some thirty members having been added to the roll.

The Association generally is in a flourishing condition ; a detailed report of the finances will be brought down by your Secretary.

I beg to acknowledge with thanks a most pressing and cordial invitation from The National Electric Light Association of the United States to the officers of this Association to attend their annual convention which was held this year in the city of Chicago a few weeks ago. I am pleased to say several members availed themselves of the pleasure of accepting the invitation and attended.

The Local Committee, as you see, have been most indefatigable in making very favorable arrangements for your personal comfort while attending the convention and also in providing social entertainments for you between the sessions. I expect every member to attend regularly and promptly at the sessions and trust the thirteenth convention, and the first held at "The King Edward," will be one of the most successful in the history of the Association.

I now declare the convention duly opened.

B. F. REESOR, President.

The President called upon the Secretary to read the minutes of the last annual meeting.

On motion of Mr. Yule, seconded by Mr. Smith, the reading of the minutes of the last annual meeting was dispensed with, and they were taken as read.

The President called for the report of the Secretary-Treasurer, Mr. C. H. Mortimer, which was as follows:

SECRETARY TREASURER'S REPORT.

The Executive Committee has held three meetings since last convention, viz : On September 12th, 1902, February 13th, 1903, and immediately preceding the opening of this convention. On September 12th two active members were elected, accounts in connection with the Quebec convention passed, and the President and Secretary authorized to deal with members in arrears for fees.

On February 13th one active member was elected, and the resignation of one member received; the dates were chosen for the present convention, and the Secretary instructed to apply to the railways for reduced rates. It was resolved that the President and Vice-Presidents should compose the Committee on Papers, with power to add to their number. Messrs. Gossler, Dion and J. J. Wright were appointed a committee to award prizes for papers of superior merit, under the terms of a resolution passed at the previous meeting of the Executive relative to the disposal of the fund donated by the Canadian General Electric Company for this object.

At the meeting this morning 25 persons were elected to membership. The membership now stands at 344, as compared with 306 at date of last report, an increase during the year of 38.

The Question Box, which is a prominent feature of our programme this year, should interest central station men, a larger number of whom should be connected with the Association and should attend the conventions. This feature is proving a great success in the National Electric Light Association, upwards of 250 questions appearing this year on their circular.

I have thought that it might be possible to organize in Toronto, Montreal, Ottawa, and perhaps other centres, local branches or clubs composed of members of the Association, which would hold monthly meetings of a social character during the autumn and winter, at some of which perhaps brief papers on electrical subjects might be presented, to be followed by discussions. These papers might be circulated among and discussed by the various clubs, and afterwards printed and distributed to the members. In this way closer acquaintanceship would be promoted among the members, at least in the cities, and active interest in the Association stimulated. I throw out the suggestion in the hope that if it meets with approval, means may be found of putting it in practical operation.

It is the opinion of some of the members, including some members of the Executive, that the important work hitherto performed by the Legislation Committee might now be carried on to better advantage by a separate organization outside of the Association. The question will probably come up for consideration at this convention.

It will be a matter of deep regret to the members that Mr. J. J. Wright, an ex-President, and one of the most useful and highly respected members of this Association, has been laid aside for several months by serious illness, and is not yet sufficiently recovered to be able to participate in this convention. The sympathy of the members will also be extended to our esteemed President, Mr. Reesor, who has been bereaved of his wife in the interval since last convention.

As will be seen by the accompanying statement, our financial position is somewhat improved, the balance in hand being $404.17, as compared with $327.11 at date of last report. This sum is exclusive of donation of $500 by the Canadian General Electric Company, which is not available for the general purposes of the Association.

[illegible]

[illegible]

Cash in Bank June 1st, 1902	$792 28
[illegible]	[illegible]
160 Active Members' Fees	480 00
31 Associate Members' Fees	89 00
1 Student's Fee	1 00
Transcribing Mr. Evans' Paper	1 00
	[illegible]

DISBURSEMENTS.

[illegible]	9 00
[illegible]	28 71
[illegible] Cheques	5 70
[illegible]	5 66
[illegible]	3 05
[illegible]	5 04
Grant to Secretary	125 00
Stenographer	60 00
[illegible] Proceedings)	108 50
[illegible] to make arrange- [illegible] F. G. Gossler	13 67
R. B. Thornton	13 68
A. A. Dion	17 85
Engravings to Illustrate Convention Papers	5 08
F. G. Gossler—Expenses incurred while President	25 00
[illegible] amount paid by him to [illegible] transcript of Mr. Lambe's Paper	3 00
[illegible]	28 59
[illegible]	880 58
	$1398 11

C. H. MORTIMER, Secretary-Treasurer.

Mr. Smith moved, seconded by Mr. Higman, that the report of the Secretary-Treasurer be received, which was carried.

The President appointed as auditors Messrs. Hunt (London), and Fisk (Peterboro).

The Secretary read letters from the following: Mr. W. A. Martin, Secretary of The Toronto Electric Light Company, extending to the members of the Association a cordial invitation to visit their stations and showrooms; from the Mayor of St. Louis and the Business Men's League, extending invitations to the C. E. A. to hold their next convention in the city of St. Louis, during the Louisiana Purchase Exposition, as it was the intention to hold an International Electrical Convention at that time.

The Secretary stated that Prof. Owens would perhaps be able to give the members some further information with regard to the matter.

Prof. Owens: The authorities of the St. Louis Exposition are organizing an International Electrical Congress to be held in the first week of September in 1904; the American Institute of Electrical Engineers, the National Electric Light Association of the United States, and other societies will participate, and the management of the Exposition is very anxious that the Canadian Electrical Association will also participate in this International Electrical Congress. It is with great pleasure I extend, on behalf of the exposition authorities, this invitation to the Canadian Association.

Mr. Higman: I would move, seconded by Mr. Smith, a vote of thanks to the authorities who have extended this invitation to our Association, and I trust that the Association will find it in their power to cooperate with the other institutes in this International Congress at St. Louis. I had the privilege of being sent to the International Congress at Chicago in 1893 by the Canadian Government, and I can speak with some authority as to the great good that the electrical world in general derived from the deliberations of that Congress. The absolute units as we have them to-day were adopted at that Congress, and legislation followed all over the world making them legal, so that we find to-day the nomenclature and the value the same in all countries. It is hardly possible to over-estimate the value of this to electrical engineering. I trust that at the coming International Congress at St. Louis efforts will be made to have a similar successful congress and that this association will assist in forwarding the movement.

The President put the motion, which was carried unanimously.

The President called for reports of committees.

Mr. Yule presented the report of the Committee on Legislation, as follows:

REPORT OF COMMITTEE ON LEGISLATION.

To the Canadian Electrical Association:

GENTLEMEN,—Your Committee on Legislation beg to report that their first meeting was held in Toronto on March 4th last. It was then quite evident that a strong attempt was to be made in the Legislature to repeal the Conmee amendments to the Municipal Act.. The situation was fully discussed and the advisability of the C. E. A. continuing to assume responsibility of caring for the companies' interests was carefully considered. At this meeting it was decided to send notices to all Lighting Companies to attend a meeting in Toronto on the 12th of March. At this meeting about 25 companies were represented out of a total of about 140 companies and individuals operating plants in the Province of Ontario. The situation was laid before those present and a resolution passed to form a separate organization consisting of companies' representatives. Mr. Reesor was elected President and the Executive Committee appointed largely consisted of the members of your Legislative Committee. At the next meeting of the Committee it was felt for various reasons that need not be gone into in this report, that it would be for the best interests of all concerned to continue the old organization for this year. Arrangements for defence were at once made and a plan of campaign agreed on. Your Chairman, although not directly interested, remained in office and gave his services to the work in hand. Mr. Mortimer also agreed to continue as Secretary for a limited time.

Mr. Downey, member for South Wellington, introduced a bill for the total repeal of the Conmee amendments and at once commenced a strong and vigorous canvas in the House to secure his Bill being passed. This being the first session of a new Legislature, there is a large contingent of new and active members who are not fully informed on the merits of the question at issue. In a matter of this kind a detail of the work done by your Council and Committee cannot be gone into, but suffice it to say that every fair and reasonable effort was put forth to prevent the passing of Mr. Downey's Bill. We are pleased to be able to report that the Legislature after full and free discussion in the House and in Committee again affirmed the general principles of Mr. Conmee's amendments as being fair and just to the companies and municipalities, in the face of a great deal of misrepresentation and ignorance on the question.

Your Committee think that it may now be assumed that the underlying principles of the Conmee Bill are considered and admitted to be a reasonable protection to those who were induced to invest capital in and have developed the lighting business to its present proportions. The future danger is that amendments to the Act will be made, and unless carefully watched these amendments may seriously jeopardize the value of your properties. Your Committee desire to say that the amendment most discussed is a clause that will compel companies to sell, or to put it another way, will give municipalities the right to expropriate. Your committee consider it will be advisable for this convention to discuss whether or not the C. E. A. should continue to assume the responsibility of looking after the interests of the companies. We state very reluctantly that in our opinion the financial support accorded the Legislative Committee by the companies falls short of what it ought to be. In a vigorous attack such as was made on the companies during the last few weeks there is no time, or in fact inclination, to stop and consider the financial situation. We felt that large interests were entrusted to us and no effort was spared to defeat such an unjust proposal; the result is that we are considerably short of funds to meet our accounts, and trust that those who are receiving the benefit of our labors will put sufficient funds into the hands of our successors in office to pay all liabilities.

The following are the names of the companies who have contributed to the expense fund of the Legislative Committee:

Toronto Electric Light Co.; Gananoque Electric Light & Water Supply Co.; W. C. Harrison, Norwood; Smith's Falls Electric Power Co.; Welland Electric Light Co.; R. A. Corbett, Port Hope; W. Moore & Sons, Meaford; Ottawa Electric Co.; Knight Bros. Co., Burk's Falls; Galt Gas Light Co.; Guelph Light & Power Co.; Wingham Electric Light Co.; Brantford Electric & Operating Co.; Renfrew Electric Co.; Hamilton & Prout, Forest; Tremaine & Snell, Exeter; Henry Cooke, Hensall; Petrolea Electric Light, Heat & Power Co.; Seaforth Electric Light, Heat & Power Co.; Listowel Gas & Electric Light Co.; St. Thomas Gas Co.; Merrickville Electric Light & Power Co.; Ingersoll Electric Power & Light Co.; Joseph Knox, Stayner; W. H. Birchard, Aurora; Simon Plewes, Creemore; Frankford Electric Light Co.; Vankleek Hill Electric Light Co.; Stormont Electric Light & Power Co., Cornwall; Napanee Water & Electric Light Co.; Light, Heat & Power Co., Lindsay; Cobourg Water & Electric Co.; Peterborough Light & Power Co.; Lakefield Electric Co.; H. W. Foulds & Co., Hastings; Bowmanville Electric Light Co.; Cardinal Electric Light Co.; James Munroe, Embro; Herbert Webster, Norwich; Tilsonburg Electric Co.; Port Dover Electric Light Syndicate; Lincoln Electric Light & Power Co., St. Catharines; Sarnia Gas & Electric Light Co.; Alvinston Electric Light Co.; H. C. Baird & Sons, Parkhill; B. A. Gordon, Glencoe; Stratford Gas Co.; People's Electric Co., Windsor; Kingsville Electric Light Co.; Ridgetown Electric Co.; Pembroke Electric Light Co.; Pakenham Electric Light Co.; John Bourke, North Bay; Carleton Place Electric Light Co.; Arnprior Electric Light & Power Co.; Sturgeon Falls Electric Light & Power Co.; Waterloo Electric Light & Power Co.; Berlin Gas Co.; Jacob Morley, New Hamburg; Bearman & Co., Chesley; Thomas Andrews, Thornbury; H. Gruetzner, Hanover; Teeswater Light & Power Co.; Walter Stewart & Son, Lucknow; Crawford & McIntyre, Durham; Hutton Electric Co., Brampton; Georgetown Electric Light & Power Co.; Clinton Electric Light Co.; Mattawa Electric Co.; Leamington Electric Light Co.; London Electric Co.

JOHN YULE, Chairman.

This report, on the suggestion of Mr. Yule, was left over for discussion, to be taken up by an executive meeting of the Association consisting of only active members, and the President appointed Thursday morning at 9 o'clock for this purpose.

Mr. Higman : Perhaps I owe the Association an apology for having no report of the Arc Light Rating Committee. I have felt, and others of the committee have felt also, that owing to the transitional stage which arc lighting is in at present it would not be desirable to bring in a report recommending a standard. We have been moving from the old open arc light to the enclosed and the alternating, and now we have the Nernst lamp as a disturbing element, and it would be quite impossible to lay down hard and fast lines as to what shall constitute a standard. I might say that the original intention for moving in this matter insofar as the Department was concerned was to induce the companies to abandon the old method of making their contracts in terms of candle power. Frequently the Department was called upon to settle disputes between municipalities and electric lighting companies, and we found with contracts made in terms of candle power—a nominal 2000 candle power lamp for instance—it was quite impossible to do anything in the premises, and so we have been advocating, very successfully I think, the making of contracts in terms of energy delivered at the lamp. That would seem to be the general custom now, and so far as the department is concerned at any rate, we are quite satisfied to let the matter rest where it is. With the limited resources at the disposal of our Association we could not attempt to take up a thorough investigation of this matter. The National Electric Light Association has been doing so and they have presented reports at their annual meetings of very great value, and which are available for our members. Even if we had the means we could not improve on the excellent work done. It will be for us to assimilate the information there prepared for us.

Mr. Hunt : I would like to state exactly what we did in a contract in London. The specifications were prepared by the city engineer. I think it gets over the difficulty of candle power entirely, that is, we have a lamp of a proper voltage and amperage, say 70 v. 6½ amp. to produce 450 watts or over. This is accepted by him as a 2000 candle power lamp and is also the standard adopted by the National Electric Light Association.

Mr. Dion : There was a committee of this Association appointed two years ago for the purpose of recommending a uniform system of accounting to the members of this Association. That committee was composed of Mr. Wright, of Renfrew, and Mr. Street, of Ottawa. They made a report at the meeting in Quebec, which for want of time was not discussed, the discussion was adjourned until the following day ; and then we found no time to dispose of it and it was left for this convention. Mr. Wright, of Renfrew, is not here as yet. Mr. Street is also prevented from coming, but he asked me to bring the matter up. He thought in fairness to the members of the committee who had devoted considerable time to investigation that the matter should be dealt with, and that their recommendation should either be set aside or adopted. The Secretary will get from his records the report presented last summer, and either at this session or some other session of this convention the matter could be disposed of. There was a recommendation contained in that report and I would like to submit it to the meeting when we get the papers before us.

The President : You have heard the explanation Mr. Dion gives. The Secretary will have these papers brought forward at another session.

There being no other business to bring before the meeting at this stage the Question Box was taken up and was conducted by Messrs. Dion and Hunt. The following were the questions sent out to members, together with the written replies submitted :

QUESTION BOX.

1. Is it advisable to "ground" secondaries at the transformer or in the building supplied ?

2. Should meters be tested in places or should they be returned to the station for that purpose ?

3. What systems are mostly used and commendable to check up lamp manufacturers' guarantees as to life, efficiency and c. p. ?

4. What has been the experience in operating single phase motors on lighting circuits and to what sizes of motors is such operation practically limited ?

5. Should 5 and 4 c. p. lamps be freely supplied to meter customers of electric light and renewals thereof made free ?

6. What is a proper annual charge for depreciation in waterpower plants, and how arrived at ?

7. What is the best practice to follow regarding the cutting and handling of wires in cities during fires ?

8. What is the best system for keeping records of poles and lines and regarding changes thereon ?

9. What is the best way for keeping track of transformers, their locations, sizes and the maximum active load on them ?

10. What precautions are advisable with free lamp renewals to prevent persons from selling them or using them in any other manner than that intended ?

11. Is it advisable to mark wires on poles so as to distinguish between feeders, mains and the different services on circuits, so a lineman may identify them without carrying a map of them in his head ?

12. What is the maintenance cost per kw. hour of the different types of Nernst lamps ?

13. In cases where machines of a different periodicity are in use, one machine 60 cycles and the other 125 cycles ; the 60 cycle machine used for the heavy loads aud the 125 cycle for the all night run ; what class of meter should be used which will register accurately within Government limitations on both frequencies. The Canadian Government require all meters to be within three per cent. either way of the average of ¼ and ¾ load. In cases like this do the Government base their figures on results obtained from tests on both frequencies, or is the meter simply tested on a machine of the same frequency as that stamped on its name-plate ?

14. I understand that there are several electrical companies manufacturing polyphase induction alternators. Are single phase machines ever built using the induction principle ? I have never seen any. I understand there is some fundamental reason for this. Is it regulation ?

15. What is the greatest distance ever talked over by telephone ?

16. What is the general opinion regardihg the use of barb wire above transmission lines as a lightning arrester ? Is the expense of installation and the cost of maintenance justified by the results obtained ? Does it give much trouble by breaking and causing shut-downs ?

17. With two high tension circuits on one pole what is the experience with the handling of repairs to one, the other being alive ? What is the highest voltage that can be so handled ?

18. Are four motor street car equipments justifiable in ordinary city service, the grades being practically negligible ?

19. What is the average power factor on plants of say 500-kw. and larger which are operating both arc and incandescent lighting and synchronous and induction motors ?

20. Would it be desirable for this Association to take up the question of preparing a publication giving the rates obtaining in this country for lighting, power, and heating service, together with an outline of the various plants ?

21. What are the factors that decide whether or not it is necessary to use bells on the ends of lead cable ? Where is the critical point, that is, above what voltage, power, length of cable, etc., etc., do they become necessary ?

22. For street lighting in small towns of 1,500 to 3,500 population, which is the better system to use ; the multiple alternating arc or the series alternating arc, and why ?

23. What size of wire is required to operate seventy-five 60-cyle, constant current, 7.5-ampere series alternating arc lamps on a circuit 18 miles long with 73 volts at arc ?

24. What method of grounding lightning arresters and transformer secondaries gives the best ground at the least cost ?

25. What is the ratio of transformer capacity to connected load for (a) residence lighting, and (b) business lighting ?

26. What should be the per cent. drop in voltage on a well-equipped alternating-current line between station and centre of distribution ?

27. What is the best way of testing meters on the customer's premises ?

28. What degree of accuracy at five per cent. of full load is it practically possible to maintain on wattmeters of the commutator type ?

29. What is the ratio of burnouts in a Nernst lamp between the ballasts and glowers of the lamp ?

30. What results, as compared with arc lights, has the Nernst lamp given for street lighting ?

31. Do Nernst lamps prove troublesome in their operation ?

32. As Nernst lamps consume much less current than other lamps in proportion to illumination, how is the customer charged for this service ?

33. Are Nernst lamps furnished by the lighting company, or do the customers, in the majority of cases, furnish their own lamps ?

34. Has anyone put Nernst lamps to a commercial use ?

35. Are Nernst lamps as efficient on watts consumed as claimed by manufacturers ?

36. What is the average life of Nernst lamp-glowers on good regulation, from practical experience ?

37. What globes have you found for interior arc lighting that are more decorative than the plain white or clear glass and, within reason as to cost and weight, while not absorbing more light than an opalescent globe ?

[illegible]

39. When meters are used by an electric-light plant, should there

is a minimum rate paid irrespective of the meter readings ; if so, what should the minimum rate be ?

40. What has been the experience of water-power plants with the maximum-demand flat rate, controlled by a Lacey controller, or similar device ?

41. Outside of cultivating a day load by supplying power, what is being done generally toward encouraging the use of summer current by water power plants ?

42. Is there any recording watt meter designed to-day suitable for measuring both inductive and non-inductive loads from 2,000 volt circuits ?

ANSWERS TO QUESTIONS.

Sherbrooke Power, Light & Heat Company, Sherbrooke, Que.:

We have been asked to answer question No. 40, and herewith enclose our reply, which is based upon our experience so far. Systematic inspection, while not having been shown to be absolutely necessary so far, would seem to us to be very advisable, and a convenient method of testing controllers in place is desirable. Many theoretical and imaginary objections to the controller have been urged which have not yet materialized in practice.

40. An experience of about six months with the Lacey controller would indicate that it furnishes the best means so far put on the market to deal with flat rates.

As to its reliability in the matter of keeping in adjustment our limited experience will not allow us to state, as we have not made a systematic inspection of them yet.

That those set up so far have remained in adjustment would seem likely, as we have had no complaint of the limit of any customer having been cut down.

Common sense would, however, dictate that this instrument, the same as any other device for measuring current, should not be allowed to go for an indefinite time without inspection and test.

Inspection in September, November and January and probably in May would be sufficient.

Its makers would add to the popularity of the instrument by getting up a convenient and portable apparatus for verifying the controller without disturbing its setting or connection.

A testing box equipped with standard lamps or some other suitable load, with an indicating watt-meter or an ammeter and volt-meter attached, and a connecting device which would admit of the outfit being quickly attached to the circuit near the controller, would probably fill the bill.

In setting the controller it must be adjusted to the load contracted for at the extreme voltage to which the circuit is subjected otherwise the controller will trip when the voltage rises, without having more than the rated number of lamps in circuit.

Our average setting allows about 60 watts to a 16 C. P. lamp.

One effect of the use of the controller is to bring home to the average customer that there is a wide range in the efficiency of lamps.

Our contract is made in terms of 16 C. P. lamps, government standard, and the customer distributes his current to his own best possible advantage.

A. G. Sangster, Sherbrooke, Oue.:

1. At transformer.

2. In some cases in places, in others taken to the station.

5. They should not be supplied free. Nothing less than 8 C.P.

6. From 10 to 25% according to fall of water.

7. The best and safest practice is to open the circuit in the fire district.

8. The map system, with location of poles, lines and transformers.

9. The card catalog, giving transformer location, maximum load, and when put up.

10. It is advisable both in station and on cross arms.

26. We have 8 circuits going out, distances being from one to three and a half miles. The drop is 2 to 3 per cent., which is about the correct loss.

39. Yes, have charged 75 cents per month irrespective of the meter reading ; this is to cover cost of transformers and connections.

40. The maximum demand rate by a Lacey controller suits quite a large class of customers, knowing the amount payable each month regardless of the hours burning. The contractor has the benefit of the load to put on a transformer—no meter readings and fewer inspections.

41. Cultivating the use of flat irons and fans.

O. Higman, Ottawa :

1. To ground secondaries at the transformer would seem to be the more preferable method. It would ensure all consumer's lines being protected ; whereas grounding in the building would often be found inconvenient and too often would be neglected altogether.

2. Government regulations require that meters should be presented to the inspector for inspection. To test in situ is extremely inconvenient and sometimes impossible. An extra fee of 50 cents is charged for meters so tested.

3. A good photometer set with standardized incandescent lamps, a low reading wattmeter and a voltmeter.

5. 5 or 8 c.p. lamps should be freely supplied to meter customers to enable them to regulate their purchases. It would tend to promote harmony as well as good business.

10. Bring the criminal code to bear on the guilty parties.

11. If wires were so marked it would doubtless be a source of great help and protection to linemen.

13. The experience of Government inspectors is that meters constructed for 60 cycles will not keep within the tolerated error if used on 125 cycles and vice versa. In all cases, so far as the Government inspection is concerned, meters are tested on the same frequency as is marked on the meter.

27. By removing the fuse wire in the fuse block on the opposite side of the one on which the supply meter is connected and bringing the current wires of an indicating wattmeter to the points thus made available and connecting the potential wire to the other side. The supply meter would not then be disturbed.

28. Most meters run slow with only 5% of full load. Except for sensitiveness the Government inspectors do not test meters on less than 25% full load.

W. A. Johnston, United Electric Company, Toronto :

Referring to question number 14: Single phase inductor alternators have been manufactured for the last three or four years in Toronto under patents of the writer. Such a machine was manufactured at first by the W. A. Johnson Electric Company and later by the United Electric Company. They may be seen in constant use in the following towns : Beeton, Acton, Norwood, Bedford, Que., Colborne, Ont., Goderich, Ont., Hamburg, Ont., Seaforth, Ont., etc. Such machines have operated successfully, running very cool and having perfect inherent regulation; it is the writer's believe that owing to imperfect regulation, and also in some cases to excessive heat, other makers have not seen fit to exploit the sale of single phase inductor alternators, and in fact some makers have practically abandoned polyphase inductor alternators for practically similar reasons.

The whole question is really one of correctness in design. The paper by the writer published about three years ago in the ELECTRICAL NEWS fully covers the ground.

The question which might enlarge the discussion in this line would be, "Why are such good results regarding regulation obtained in transformers as made by almost any manufacturer, whereas when same iron and copper is used to construct a generator poor regulation is obtained and usually the endeavor is made to compensate for or correct such irregular generator by use of compound windings, etc."

Brantford Electric & Operating Company :

In answer to question No. 9, "What is the best way of keeping track of transformers, their location, sizes, and the maximum active load on them," we have found our system in use here for keeping track of the above very satisfactory, and same has often been the means of saving transformers from burn-outs due to overloads. When a customer is connected, and the order of same is returned, the transformer number is handed in by the foreman. This number is placed on the customer's card, and the customer's name, together with the number of lights and the estimated average maximum load, is entered on a card, which is filed in a card index, according to the transformer number. This card, which is 4 to 6 inches, shows in addition to the number, the size, make, voltage and type, and also shows the date purchased, from whom, and the price. Columns are left on the face of it for the date of installation, circuit, location and date and reason for removal if any. On the back of the card three columns are provided, one for customer's name, one for number of lights connected, and the other for the estimated average load. These cards show at any time the number of lights connected on each transformer and also furnish a rapid means of finding out the numbers and sizes of transformers connected on the lines. We enclose herewith copies of transformer cards in use by us.

(Front of Card.)

Size of Transformer.		Make.	No.
Voltage.		Type.	Inst. by.
Purchased.		Bo't from.	Price.
Installed.	Phase.	Location.	Removed and Reasons.

(Back of Card.)

No. Lights.	CUSTOMER.	Aver. Load.

Mr. Hunt : Mr. President, the meeting of the Executive this morning was kind enough to appoint Mr. Dion and myself to take charge of this Question Box. I might state that in the National Electric Light Association of the United States, which held its meeting in Chicago this year, we had a great many questions, nearly three hundred, put in by members during the year. The Secretary sends out papers about every month with the questions that have been submitted and each member is requested to answer, if he can, one or more of the questions that have been sent in, and by that means a great many answers are obtained before the meeting—so much so that when we met in Chicago this year the Secretary had a book almost half an inch thick printed with the questions and the answers following. We found it of very great assistance. I might say some of those books have been sent to members of this Association, and I heard one gentleman this morning say he thought it was the most valuable book printed in the electrical line. Next year the Executive Committee might, I suppose, find it possible to do this work in a similar way and save a lot of discussion at our meetings which takes up time. However, we must make a beginning, and with your permission I will read the first question and ask some of the gentlemen present to give us their views on it. The first question sent in is one of very great importance and I think possibly there is some difference of opinion on it. "Is it advisable to "ground" secondaries at the transformer or in the building supplied ?" I might state here that there was some difference of opinion among the Chicago members, some saying it was better not to ground them at all and others contending that it was.

The President : Perhaps some member present could give an answer to that or give his opinion about it—some central station man.

Mr. Fisk : Mr. President, I might say at Peterboro we are grounding all of our late secondary work, especially the three wire ; ground the neutral and ground at the transformer, and so far we have not grounded anything in the building. It has worked very satisfactorily.

Mr Dion : May I ask Mr. Fisk what means he takes for grounding on the streets ?

Mr. Fisk : Simply put a copper plate down in the ground about seven inches deep, about twelve inches square, nailed to the bottom of the pole, and a copper wire soldered to that.

Mr. Dion : Do you know of any breaking of the joint ?

Mr. Fisk : We have never found it so.

The President : I think good moist ground would be sufficient one way or the other.

Mr. Higman : It seems to me that the most effective way of doing it, if it is desirable to do it at all, and I believe it is, is to ground the secondary at the transformer. I do not think the plan adopted by Mr. Fisk is a desirable one. Electrolytic action will soon destroy the connection and there will be no ground. The only effective way is to string an iron wire of good size grounded at some central point. The grounding of the secondary is quite a common and usual practice in Europe.

Mr. Hunt : Where do you run the iron wire ?

Mr. Higman : On the poles, following the transformers.

Mr. Hunt : I understand that the National Board of Underwriters have now some objection to grounding at the transformers. It seems there has been trouble through having grounds at the transformer and also from grounding inside of buildings where there are water and gas pipes. There have been some fires caused on that account, where the ground wire is crossed by a water or gas pipe in the building.

Mr. Dion : I think the question is not exactly whether we should ground secondaries or not. The question upon which there seems to be considerable difference of opinion is whether we should ground the secondaries at the transformer or in the building. It seems to me we have no choice in the matter, because the National Code will not allow grounding except outside the building. If you ground it outside of the building it seems to me it is a matter of indifference whether it is immediately outside or half way to the pole or at the transformer. There is a written answer which I wish to read to read to you. Mr. Sangster, of Sherbrooke, says : "At the transformer."

Mr. Hunt : The next question is : Should meters be tested in place or should they be returned to the station for that purpose ?" There are two answers to that, one from the Sherbrooke Power, Light & Heat Company : "In some cases in place ; in others taken to the station." Another answer, from Mr. Higman, is : "Government regulations require that meters should be presented to the inspector for inspection. To test in situ is extremely inconvenient and sometimes impossible. An extra fee of fifty cents is charged for meters so tested."

The President : Are there any other answers to that ?

Mr. Fisk : We bring all our meters in for inspection. It is almost impossible to do anything to a meter that is on the premises, if found incorrect. We have found it better to bring them in where everything is handy for correcting the meter if it is wrong.

Mr. Higman : In many instances the meters are tested on the company's premises ; that is the case in Toronto. Accommodation is made for testing the meters and the representatives of the companies and our own inspectors work together. It would seem to me, apart from the regulation, to be desirable to bring meters in and give them a general overhauling and cleaning up. Some meters are placed in positions where it would be absolutely impossible to adjust them ; they are stuck away up in a dark closet near the ceiling ; we find many of them in such positions. There are no conveniences at all for testing meters in situ and for this reason we do not encourage the practice.

Mr. Yule : I would like to ask Mr. Higman if it is not found, in the case of disputed accounts where the correctness of the meter is disputed, that if the meter is first tested on the premises, and they are notified to be present, that it gives added confidence in the decision of the officials ? My opinion is that it would, where that was done.

Mr. Higman : Possibly. But the regulation states that in case of a disputed meter the seal shall only be broken by the inspector ; no other party would be able to tamper with the meter.

Mr. Yule : I say to test it as it stands and is connected on the premises.

Mr. Higman : If you can make a satisfactory test it is alright.

Mr. Saxby : I think we should have the privilege of having the meters inspected on the premises, because in that case where there is a large bank the labor would be done away with.

Mr. Higman : In the case of 500 volt power meters, they are often tested where they are in use.

Mr. A. Sangster : I have had occasion to test them in the premises sometimes. This past week I had occasion to take out two meters. The customers thought they were going too fast. In one instance one of them was five per cent. slow and in that case the customer said that we had tampered with the meter before we tested it. Therefore, I state in some cases it is necessary to test them in place. It is according to the customer you have to deal with. I gave the answer according to my experience. The only way to do it is by putting on the lamps and running for an hour without touching the seal or anything and then showing the reading ; then if the customer is not satisfied we take the meter out and take it away for Government inspection, and give the customer notice of the Government test so that he may see the meters tested if he wishes.

The President : It is a good practice and one which we have followed. We have invariably brought our meters into the bank where the Government inspectors test them, but it is a good plan in some cases to put another tested meter in parallel with the one that is in place and let the customer see how they run and tally one with the other. It works very well, I think.

Mr. Higman : Of course, the disputed meter could be handed over to the inspector in the presence of the customer.

Mr. Purcell : I have in mind one meter, and when we tested it in the shop it ran alright, and we sent it out and had it put up and in one month that meter had crept 24 kilowatt hours. There was vibration in the building in which it was put up. There was no vibration in the building in which it was tested. I think there are some instances in which you have to make tests on the premises.

Mr. Saxby : I had one case of that myself in connection with one of the old type of meters. I noticed the very thing that Mr. Purcell has mentioned, that the meter started to run faster with the vibration.

Mr. Purcell : I might say the Edison people in the city of Detroit insist on all meters being tested on the third floor of their power house, where there is a great deal of vibration. Originally they used to receive their Thomson meters from the General Electric Company that were tested on an air bag so as to eliminate all vibration that there might be. When the meters were received and put up for test they found that they were possibly anywhere from ten to twenty per cent. fast. They specified that these meters must not be tested on the air bag ; they must be fastened to the wall or shaft or anything convenient so as to be liable to the vibration of the building—every day conditions—and that they do now ; they test all their meters on the third floor of their power house where there is vibration from the machinery which is below, and they get every-day conditions, and as a result they have very few objections. Of course, on the other side they have no Government meter inspection for electric light, it is simply their own inspection, and they make a very close inspection. Mr. Clarke, who had charge of that department, is quite a capable man. I was very much pleased with the way he explained things for me in connection with that matter when in the city of Detroit five or six weeks ago. We have vibration from trains as well, in the building I refer to, and those meters when tested on the premises and in the shop show a difference of fully five per cent. and possibly a little more than that.

Mr. Higman : I might say in a general way that the percentage of meters that run outside of the toleration of error allowed is very small even after working for some years, and these are cases that it would be almost impossible to make any general rule to meet. You will find these exceptional cases ; I do not see that we could make any provision for them.

Mr. Purcell : With reference to testing the meter on the premises, we make it a rule that the wiring must be run to a point which is easy of access, not more than eight feet high, on the wall.

Dr. Johnson : Although in the employ of the Government, I have taken the liberty of sometimes not adhering closely to the rule. In cases where people have doubted the accuracy of their meters and thought they preferred to see a test on the premises, I have done so to please them without any extra charge. It is very seldom I have to do it. As a rule they are quite satisfied to see the meter taken away, and I usually ask them to be present at the test. When they see the seal broken by me or some of my assistants and see the test made they are always satisfied. I hardly ever had a case where there was any doubt thrown out about it being interfered with. I always bring to their attention the fact that the seal is there and has been unbroken until it is broken by me, and they nearly always have been satisfied, but once in a while we test on the premises if they desire that.

Mr. Yule : I would like to congratulate Mr. Higman on the entire absence of punctiliousness amongst the officials in his department ; they do their duty and do what is right and take special pains to deal with the customers.

Mr. Higman : That calls for one word more from me and it is this : That from the very outset I have laid down the principle that people engaged in the electric lighting industry were honest men trying to do the best for their customers. I have never yet found a single instance where an electric light company laid itself out to cheat the public. Working along those lines we have experienced no difficulty in maintaining amicable relations with this important industry. (Applause.)

Mr. Hunt : Question No. 3 is : What systems are mostly used and commendable to check up lamp manufacturers' guarantees as to life, efficiency and "c.p."? I have one or two answers to that : Mr. Higman suggests a good photometer set with standardized incandescent lamps ; a low reading wattmeter and a voltmeter. I think that covers the whole thing because it is not very extreme and it is very efficient.

Mr. Fisk : It is well to add to that a competent man with very little else to do.

Mr. Dion : This question perhaps may be taken in another way : What is the best system of testing incandescent lamps? It may be put in other words : What means do you take to ascertain whether your lamps are correct or not ? Apart altogether from the instruments which you use there may be different ways of getting at that. For instance, it is not practical to test every lamp, but a certain percentage may be tested. The system we use, which is probably the same as that used by a great many other companies, is this, we take five per cent. of all the lamps we get ; for instance, in a package of 300 lamps we would take fifteen lamps at random and put them through a photometer test and also connect them with a wattmeter immediately after and note the candle power and the wattage, and we plot that on a printed form with a target in the centre, and the lamps must test within the allowable limits of candle power and wattage. These limits are set when we make our contracts with the lamp manufacturer and form the boundaries of this target. We insist that at least sixty per cent., three out of five, of the lamps tested shall fall within that target—that is our rule—and if we don't get this result the whole package is returned to the factory. Those are the terms of the contract and we try to follow them up. We might test a larger percentage of lamps, but some such system as that must be followed, because you cannot very well test every lamp. Then apart from that lamps are selected from time to time, one or two out of the package, and put on a board for life test. This part of it, I am sorry to say, has not been carried out very systematically. We have not carried on life tests continually, but we from time to time made life tests. With regard to the remark by Mr. Fisk as to a competent man, we found that a young man who was the store-keeper—had charge of the lamp stores and some other things besides—was quite competent to do this. He was put in charge and took a lively interest in it. He was coached for a while and soon gave very good satisfaction. We had a dispute last year with our manufacturers and a lot of 25 lamps was sent to the testing bureau as a referee, and we were glad to note that our store-keeper was doing very well. So that I do not see that it is necessary to get a expert; I think an ordinarily intelligent man can be coached to do that. I do not say that he would do in a lamp factory or where you want particularly accurate tests, but for the ordinary run of commercial tests I think it can be done in that way. We use standardized lamps. Our standards are supplied by the lamp testing bureau of the United States, they have two grades, a cheap standard and a closer standard which is more expensive; they cost $2.50 a piece, I think.

Mr. Hunt : The next question is No. 4 : "What has been the experience in operating single phase motors on lighting circuits and to what size of motors is such operation practically limited ?"

Mr. Lambe : I don't recall anything larger than about five horse-power, generally smaller in this country.

Mr. Russell : I am representing the Wagner Electric Mfg. Company, builders of single phase motors, and although I cannot give you any particular data still I can speak from general information. It seems that the size of the motor which you can operate on lighting circuits depends to a great extent on your own local conditions. Now, take Newark, N. J., they are using as high as a 35 horse-power on their system, which is multiphase ; there are other systems where they have less than 100 kilowatt generator capacity, and they have 30 horsepower motors ; take in some cities they are only allowing as high as 5 horse power. Central station managers, it seems, will put on any size of motor which can be placed on a circuit, and the load being thrown on and off, will not give them a greater fluctuation in voltage than they can stand for proper service to their customers.

Mr. Hunt : That depends on your transformers and your line ?

Mr. Russell : That depends on your line capacity.

Mr. Higman : What is the largest motor you make on single phase ?

Mr. Russell : 35 horse power.

At 12.45 o'clock p. m., the Convention adjourned for luncheon.

AFTERNOON SESSION.

2.30 o'clock p.m., the President called the Convention to order, and called upon Mr. C. F. Scott, Pittsburgh, Pa., to read a paper by Mr. Paul Lincoln, Pittsburg, Pa., on "The High Tension Engineer."

Mr. Scott read the paper, which is printed elsewhere.

Mr. Chas. F. Scott : In conversation a little while ago this question was asked : How has the advance in electrical engineering in High Tension work been conducted in the past, who has done it ? A gentleman replied : Mainly by the manufacturing companies. I think this is true—these companies have developed experts ; they have sent these experts out over the country ; they have built new lines of apparatus, carried on laboratories and investigated to determine what is most suited to meet your conditions. The primary business of these companies is to manufacture apparatus but they have had to come and take the place of the consulting engineer and the text book ; they have had to develop the engineering itself and to tell you what you need and how to operate it as well as to build and to sell you the apparatus. Is it not time that you gentlemen co-operate now in contributing the experience which you have, either formally through your Association, or as individuals ? In what way ? You can contribute of your experience to help along this profession upon which we are all so dependent.

The manufacturing companies have also taken the lead of the operating companies in appreciating the value of the young electrical graduate in their business. They have provided apprentice courses ; they take them in large numbers ; they educate them for their own work and for you. This, the engineering work, the experimental work which they have done, must be paid for and is paid for naturally through the apparatus which you buy. As you assist in cutting off that element of their expense it will be a factor in cheapening the cost of electrical apparatus. I am glad to appear before you and speak as President of the American Institute of Electrical Engineers. I am very glad to be present to-day and to see such a substantial gathering of electrical men on this side of the border. The American Institute has been broadening in its work not only in connection with power transmission as Mr. Lincoln has pointed out, but in other lines also; it has felt it should be in touch with more men and particularly with the younger men who are growing up in the profession. It has presented to young engineers and to older ones as well the advantages of becoming members of the Institute and also the responsibility which they ought to feel to accord their support to an institution of the character and of the activity which the American Institute has. Formerly the American Institute has had its monthly meetings in New York which have been attended by a local audience. There have been one or two other places where meetings have been held, but this year a great extension has been made by the formation of local branches. They have been formed in the principal cities ; in Boston, Washington, Philadelphia, St. Louis, Cincinnati, Denver, Pittsburgh and in other places ; the one in Chicago which had existed before has taken on new life. Meetings have been started also in a large number of colleges. College professors meet with their students, or an engineering society of students constitutes itself into an institute meeting. At these local branches the papers presented in New York, together with the discussion of the papers held in New York, are presented, so that the local branches have better material than the New York meeting itself, having the discussion in addition to the papers. This has awakened a good deal of interest and activity and it has taken very well among the college boys, and a number of professors have said to me that the results were of far greater value than they had anticipated. Within the last week I have had the pleasure in our secretary's office of reading over a report which has come from Toronto of the formation within the last two weeks here of a local branch of the Institute for the purpose of taking up Institute papers and strengthening the institute in this region. I think that is a most excellent move and I predict success for it. In these later days we are beginning to appreciate more fully the value and importance and meaning of co-operation ; it is coming among engineers, I think brought about very largely through the electrical engineer ; he does not do very much himself ; off by himself he does not amount to much ; he has to come in and stir up the other engineers. The hydraulic engineer had a quiet sort of a time until the electrical engineer got after him. Now he has to work ten times as hard. The steam engine men gave any old kind of an engine and it did the business for a while, but when the engine had to run a dynamo there were new speed requirements. The mechanical shop engineer did not have to know very much except to run a shaft and figure out the size of a pulley, but when the electrical engineer got into the machine shop he revolutionized the whole thing. The tools now are not strong enough. I think it means a great deal ; it points to the tendency in modern times when we look at a little incident like this : The superintendent of our factory at Pittsburg made the remark with reference to tools that were being bought for an extension of the factory, that although the tools were no larger, yet an expense of something like fifty per cent. additional was being paid in order that the tools might be made to run faster and do more work on account of the conditions which had come in through the new kinds of tool steel and through the electric drive. The electrical engineer binds together other engineers instead of working independently. I instance the Pennsylvania tunnel in New York, where civil and mechanical and hydraulic and mining engineers are interested along with the electrical engineer. All have to work together. That is one of the points to remember and observe with respect to this young man we are trying to develop and bring up to handle our work properly. He needs to be all kinds of an engineer ; he needs to know how to develop, to match up and fit in all kinds of engineering work. The dynamo man is one of the smallest men about the whole concern. Down in Pittsburg the big dynamos for Niagara Falls used to overawe everything else in sight. Of course, water wheels are common and didn't seem to amount to very much ; the dynamo was the great thing. But when I got up to Niagara Falls and saw those little insignificant machines in so large a station and when I went down into that great wheel-pit and heard that noise and saw those long shafts and those great big water pipes and all that sort of thing it seemed to me that the dynamo was the smallest part of it all. Bnt it is the electrical engineer who must see all the other things fit in and work together. The electrical system is the central system ; all the other have to fit to it and be satisfactory to the electrical conditions. Now, regarding co-operation, one of the men who has been most successful in industrial work in this country in building up a magnificent organization, who has given great attention to the mechanical processes, who has believed in throwing away a thing quickly as soon as there was something better in sight, a man who has built up a great company, by getting men who knew more about each branch of the business than he did himself of organizing the men as well as the machinery, the man who has amassed a great fortune, one of the greatest the world has ever known, this man has recognized the advantage of engineering work and of engineering societies and of co-operation--"engineers need to get together" are his words—and he has done one of the most magnificent things towards co-operation and towards engineering work in its broadest sense, and that man is Mr. Carnegie, and the act is the gift of $1,000,000 towards a great engineering building in New York for the National Engineering Societies. (Applause) These big societies are being recognized; a practical man has recognized them; and these other societies, these societies, such as yours, which take a particular line of work in a particular part of the country, they should recognize they have a part in the onward advance of work of this kind. I ask you as individuals and officially as members of the Canadian Electrical Association to consider that the American Institute of Electrical Engineers is ready and glad to co-operate with you as a society or as individuals and to receive your assistance in pushing forward the work which it has undertaken. (Applause)

The President: This is a valuable paper which we have had and it has given time to follow it up a little. If Mr. Black is in the room I would like if he would give us a little information or a few pointers.

Mr. Dion: I understand Prof. Owens is here; he is professor in the leading school of electrical engineering in this counry; I should be glad to hear from him as to the college end of the discussion.

Prof. Owens: Both Mr. Lincoln and Mr. Scott have outlined the relations which should and in the main do exist between the college and outside work so clearly that remarks by me are hardly necessary. However, it may be said that within comparatively few years there did not exist as complete and as satisfactory an understanding between the college people and the manufacturing word as now, I am glad to say, does exist, due in large part to the interest in college work shown by such men as Mr. Scott, Mr. Lincoln, the officers of the General Electric, the Bullock and other large manufacturing companies. They now perfectly well understand, I think, that a college does all that it can be expected to do when, in the short time it has at its disposal, it gives to students some knowledge of the fundimental principles which underlie all engineering work. The tendency in engineering education now, as far as I am able to observe, is to instruct in the principles. No university can operate a manufacturing establishment and give to the students a knowledge of manufacturing details. It is quite out of the question. It is most significant, however, that the majority of the larger electric manufacturing companies select their young men almost entirely from college graduates, saying at the same time that they do not expect every man who comes from the college to make a engineer, but that it is the best material from which to draw. Now, I believe that their are men going out from colleges to-day perhaps better trained than they were only a few years ago. To me, as a man connected with an engineering school, I must say that if it is so it is largely due to the interest and assistance of outside men. I remember very perfectly the difficulty ten or twelve years ago I experienced in obtaining permission to visit the works of one of the larger companies, but I was fortunate enough at that time to know Mr. Scott and I got into the Westinghouse Company, where I spent one summer. If you, gentlemen, who own and operate lighting plants desire your engineer to further inform himself about high tension work or some special form of new apparatus that any of the larger companies is manufacturing you may send him to such a factory and he will be kindly received and will be shown everything, and he will go away with very much more information than he had when he came. In line with what Mr. Scott had said you might also send your men on trips of inspection for the purpose of studying local conditions which are similar perhaps to those which obtain in your own plant. If the college education is supplemented by this sort of training you will then have or should have an engineer. The college does not make you an engineer, the college graduate is not an engineer. But he is a man who is much more likely to become quickly an engineer than a man who has not had the college training, yet it is only the beginning of his work; nothing in the world can take the place of experience. A man is not an engineer until he is supplemented in the knowledge of the principle with experience. I think that is very well understood now both by college men and those who are employing engineers, and it is largely due to such gentlemen as Mr. Scott and others who have spoken.

Mr. Black: Mr. Scott and Prof. Owens have spoken for the educational and manufacturing end of the subject, and I might say a word with regard to the operating end of a transmission plant. I was very much struck with one remark to the effect that when things were designed and planned out so that you would naturally expect them to work perfectly, that did not always work that way. I think that has been the experience of everybody who has had to do with the operation of electrical machinery. I was much pleased to notice what Mr. Scott said about engineers getting together and trying to work together for the benefit of electrical engineers at large. It is very gratifying to younger engineers to find men of large experience who are willing to give them the advantage of their experience.

Mr. Lozier: If I may take the floor for a minute. In the subject that has been discussed the point which seems to be of the greatest interest to all is the preparation of the electrical engineer for his work. We have heard from Prof. Owens that they prepare him for his work; we have heard from Mr. Scott how they finish the product. I have had a good deal of experience with young men going through the shops, in the expert course, and if there is one suggestion that I might offer it would be this, a man goes to college and he will probably take a four years course. Many of the men who go to college feel when the summer holidays come it is a good time to rest up. That may be be very true, but it is also a very excellent chance for those men to learn during the summer holidays what would be most useful to them during the next term of college. I don't know whether it would be too radical to suggest that for an electrical engineer it would be of advantage to him if he could take a shop or practical course, so as to get a short experience the first year before he goes to college so that he would be familiar with the things which he would afterwards learn in the text books. If there is any virtue in the suggestion at all it would be to mix the two together as far as circumstances enable a young man to do so.

Prof. Owens: In line with what Mr. Lozier has just said, it may be of interest to state that in McGill University at any rate the students are required to spend three months of each summer term in practical work, and we find it of the highsst possible advantage to them.

Mr. Scott: If you will allow me, I don't think we are hearing enough from the other side. This general subject was under discussion at the convention of the National Electric Light Association at Chicago a week or two ago and one of the station men said this; The trouble with the young engineer in the electric light plant is the manager of the electric light plant; the manager and the people around the electric light plant, when a young engineer comes in, they secret their information; they keep it away from him, they do not give him anything. Prsident Pritchett, of the Massachusetts Institute of Technology, not long ago went through a factory in which he found a Returned Material Department; he was very much interested in that; things which did not work right came back, and the company gave particular attention to find out why, whether it was some fundamental lack in the design or some fault in the construction or whether it had been misused. He said he thought colleges ought to have Returned Material Departments to find out why it was that these young men who went out did not always succeed. You are the men who use the apparatus and use the students, and if the apparatus is not right you send it back in a hurry, whether you explain fully what is the matter or not; you may not be too explicit about it, but the apparatus comes back all the same. What about the students? Is Prof. Owens turning out the right kind of students and if not why not, what is the matter with them? I think it was that retired merchant in his letters to his son who said "The college does not make fools, it only develops them. And it does not make intelligent and able men, it only develops them." You have got to have the right kind of material to start with and the college can help it along. If you get the wrong kind of fellow that has come through college he will never make the right kind of engineer. Is that the kind of fellow you have got? Have you had some of these young engineers who have been more bother than they are worth, or not? Let us hear from the other side.

Mr. Dion: Speaking on the subject of Mr. Scott's discourse I think the reason why he does not get a response when he asks central station managers to give their experience with regard to college graduates is the fact that the college graduates have not been employed in any large numbers by the operating companies in this country. I think it has been the custom largely—probably owing to the fact that the companies are small compared with those of the larger cities in the United States—for the men to be drawn largely from local material which has been trained up in a practical way to fill the different positions in the operating department. Graduates have mostly gone over to the United States and they have acquired some practical experience there, and they sometimes come back to take important positions here, but their practical training had been obtained mostly on the other side after they left college. One thing that occured to me during the discussion was this, that university professors whom I have heard on the subject or whose opinions I have read, as well as the leading engineers in the manufacturing companies, men who have had experience with graduates, all seem to agree that the colleges do not produce engineers but only prepare material to make engineers. This seems to be generally recognized. Nevertheless, it is a practice of colleges to grant degrees and to give a man the title of "Electrical Engineer," and this, it seems to me, has led to some little misunderstanding with the employing public who sometimes do not understand the practice of the universities in that respect. I remember a few years ago, following an animated discussion in the electrical press of the United States as to whether graduates should be labelled "Electrical Engineers" or something else, and some of the professors of the universities as well as outsiders held that the degree should be known by some other name, Bachelor of Engineering, or something of that sort. However, I think this Association is going to benefit and all the members who are here to-day will certainly benefit by the remarks of Mr. Scott on a subject which he handles so well. I personally believe in co-operation. I think it is impossible to accomplish very much in any line of effort without co-operation, and Mr. Scott has shown himself to be a very strong advocate of it. He has pleaded for it on every occasion when he has had an opportunity to express himself, and I do not know of any man in America who has done more towards co-operation or towards what will produce in the near future active co-operation between the different engineering bodies than Mr. Scott has done during the past twelve months. (Applause) I think if we knew the true inwardness of the Carnegie grant Mr. Scott would be found to have had a good deal to do with it. He has told you of the progress that has been made by the American Institute of Electrical Engineers during the past year; this progress has seemed most remarkable even to those who are at a distance and cannot keep in close touch with the Institute; and this result is due in a large measure to Mr. Scott's personal efforts as President of the Institute. Any one who has followed the work of the Institute at all must recognize that fact. I have very much pleasure in moving a vote of thanks to Mr. Lincoln, who wrote the paper, and to Mr. Scott, who supplemented it by a discourse of such benefit to this Association.

Mr. Hunt: I have great pleasure in seconding that. I might say I was at Chicago the week before last. I know that the National Electric Light Association took deep interest in anything that Mr. Scott had to say to them; they were very glad to hear from him.

The President put the motion, which, on a vote having been taken, was declared carried amid applause.

Mr. Scott: I thank you very much. If I may be allowed one more remark I would like to say this: One gentleman in speaking in discussion called attention to the exchange of experience; at the National Electric Light Association in Chicago there was an admirable example. During the year different members of the Association by request had sent in questions that they would like to have answered. These questions covered a very great variety: "What has been most satisfactory in small towns, meter or flat rates or a combination?" "What is the best incandescent lamp base to adopt and why?" "What methods have been used to provide a fairly uniform temperature for storage batteries of a given capacity?" "What is the best method of making temporary repair to a belt 16 inches in width?" These are a few of the questions selected at random. They cover the whole range of station experience. These 257 questions were then sent out to the different members of the Association for reply and most of these questions have from two or three to half a dozen replies, signed by the men who made them. 125 different individuals have replied, some of them to one question, some to as many as 100 questions. It seems to me that this is one of the best things, one of the best undertakings and the best work that I have ever seen for accomplishing its purpose, and I am very glad to see that your Association is taking up some of the same kind of work. The American Institute of Electrical Engineers, I think I omitted to state specifically, would be very glad to see any of you gentlemen at its convention in Niagara Falls the last two days of this month and the first two days of next month. (Applause)

On motion of Mr. Hunt the convention adjourned until Thursday morning.

SECOND DAY.

At 10.15 o'clock a.m. the President took the chair and called the convention to order.

The President named as the Select Committee to strike the Standing Committees: Messrs A. A. Dion, Ottawa; John Yule, Guelph; and W. Williams, Sarnia; after which he called upon Mr. Lozier, of Cincinnati, Ohio, to read his paper on "Variable Speed Motors and Their Relation to the New Shop Methods."

Mr. Lozier read his paper, which is printed elsewhere.

In connection with his paper Mr. Lozier used the Cooper curve, which was shown on a diagram, and which he explained to those present.

The President: You have heard this valuable paper by Mr. Lozier. There should be discussion upon it as it is a question of vital interest to a great many central station people, especially those supplying power.

Mr. Hines: I would like to ask Mr. Lozier as to the relative cost of maintenance of the multivoltage and direct current motor systems, as applied to small loads.

Mr. Lozier: Mr. Hines has touched on a very important point. There are two considerations involved in this proposition, one is the investment which carries with a depreciation, and the other is what you are going to get out of this investment. We ought to give due consideration to both of these points. The direct current motor that is being used to-day on tool practice is quite a different kind of a bird to the motors that have been used in the past. The depreciation of these motors is very low. In the first place the motor does not run at its full capacity all the time and in the second place it has actually no sparking, it is designed so that it won't spark. The depreciation is rather difficult to state exactly, but I think we are quite safe in saying it will not in any event exceed six per cent. Very good. We will take that as a fixed quantity. Now, against this depreciation we have: What can the motor do? When we are considering this six per cent. depreciation we want to figure what that will cost on the investment. We will take a concrete case. We will say a tool equipment for a shop costs $50,000 and we will take six per cent. of that as the depreciation or $3,000, and we will say that $50,000 equipment is sufficient for an establishment turning out $1,000,000 worth of stuff. That is a pretty big equipment for that output but we will take it on that basis. Take six per cent. on that it gives $3,000 as our depreciation account. We will double it; we will say the depreciation is $6,000, and multiply it by four and say it is $12,000; in other words we are assuming a depreciation of 24 per cent. and that our motors will only last for about four years; we will say $24,000 is our depreciation. In that case we have got an equipment turning out $1,000,000 worth of stuff a year. With the individual directly applied motor we can increase the output of that shop perhaps 30 or 40 per cent., but let us take for this comparison about 10 per cent. which now gives us an output of $1,000,000 + $100,000 or $1,100,000 output; we are going to take 10 per cent. more out of it with the same fixed charges and the same pay roll; we have got to use a little more material; we have got $100,000 to the good; we will take out for material 20 per cent.; so we have got $80,000 increased value of production against $24,000 which is the exaggerated depreciation we assumed to illustrate the case. Now, you can use a pretty expensive kind of a motor on a proposition of that kind. Does that cover the point?

Mr. Hines: that covers the point.

Mr. Gossler: Mr. Chairman, there was another point touched upon in Mr. Lozier's paper and one which I think very important especially from the operating point of view. I have reference to the individual tools giving a higher output for the same investment or rather increasing the load factor of the shop. I think the experience I have had up to the present, shows that the load factor of a shop, especially a machine shop, is somewhere between 30 and 60 per cent., I think 60 is very high; consequently the charge which should be properly based for power on maxium demand will have to be greater than if the load factor was higher. Anything that has a tendency to increase the load factor or keep constant the maximum demand for power, will certainly permit of decreasing the cost of the power. Another point that has been touched on slightly here by the first speaker, is that of alternating and direct current motors. I think it is well established that the general system of distribution is that of the alternating current, and anything that will tend to simplify the system and permit of the use of alternating current motors, I think will be a very great step in the progress of the utilization of motors directly connected to individual machines. I trust that matter will be dwelt upon by those capable to speak upon it.

Mr. Hims: I would say if we could have an alternating variable speed motor undoubtedly we would have the ideal factor in shop development, but unfortunately we not able to vary the speed of an alternating motor except within certain limits. Now, of course, in the system of distribution the alternating motor is far simpler than the direct current motor, we grant, but the direct motor appears in the machine shop to be far more flexible with the maximum out-put. If you put a man at a machine on the piece work system and you want to get all out of the machine and man you can it would appear to me from the present standpoint that the direct current motor was best adapted for that work even allowing a large depreciation, but it seems to me with the increased out-put and the figures Mr. Lozier gives all the economy of the alternating current motor and distribution system would be more than counter-balanced by the increased out-put obtained from the direct current motor. There seems to be a large diversity of opinion as to whether it is best to equip with the direct current motor and apply individual motors to almost every tool of 5 h.p. or over or put in the alternating current motor and group your tools.

Mr. Leonard: Mr. President, this matter of shop operation is particularly interesting to me just at present, and I have been thinking about it a little. Our conditions in Canada are peculiar because all our plants are operating on the alternating current system and it is rather difficult to obtain the direct current for variable speed purposes unless some means of convertion—a motor generator set or something of that sort—is utilized. Under those conditions for shop operations it strikes me that a system employing alternating current induction motors for all constant speed work is the ideal system that would be carried out, according to my ideas, as far as possible in heavy tools running at constant speed, on group tools, on galleries or portions of the shop not served by cranes; the balance of the shop, as for instance the lath work and portions of the shop where heavy tooling is tn be done, would be operated by a variable speed method using direct current motors. To obtain this class of current from the central station it would, of course, be necessary to use a motor generator set, but, as Mr. Lozier has pointed out, the cost of this set and its depreciation cuts so small a figure on the output of the plant that it is hardly worth consideration. To be sure it involves an extra loss in the mere matter of transformation. But utilizing, as I suggested, the alternating current for heavy tools at constant speed and then operating all the variable speed work with direct current motors gives a system which, it strikes me, fits the machine shop practice in this country as closely as anything that can be obtained.

Mr. Hines: There is another fact that has to be taken into consideration and that is the transformer losses.

Mr. Leonard: Without prolonging the discussion too far, transformer losses are involved by the alternating current system, but the transformer losses only equal the line losses in the direct current system. To make the allowance for a rotary transformer or a motor generator set, there are losses no doubt with our system in Canada which are losses from the alternating system, which become necessary if the direct current is used, so that we not only have the alternating current transformer losses connected with the central station but we also have the rotary transformer losses in order to obtain the direct current. Notwithstanding all this the percentages are so small that considering the advantages for variable speeds I think probably in most cases it will be advisable to use part of both styles of motors.

Mr. Lozier: If I may take a minute, the proposition that Mr. Leonard makes of the combination of the alternating current motor with the direct current motor may be very true. I am talking about the variable speed motor in its application to new machine shop practice. And if the alternating current motor has any advantages for constant speed work that the direct current motor has not got, by all means use it. Abe Lincoln says, "If you like that kind that is the kind you like." But, there are a whole lot of things to be borne in mind; the question has to be gone over very carefully, for in the first place the advantages of the alternating current motor over the direct are not so great from the sparking standpoint as they used to be. The compound direct current motor is a very good servant, highly efficient, good on starting torque, has not got any power factor, it is a good mechanical device. Another thing that you must bear in mind, and I am not advocating against the alternating current motor when I say this, and that is the interchangeability of your motors. The modern machine shop to-day places the order with the manufacturer for one dozen 6 h.p. motors, shunt wound, speed 600 revolutions, voltage 120, or twelve 10 h. p. motors, speed 600 revolutions, etc., and it takes those motors out of its storeroom shelves the same as it would go there and get so many lines of shafting or so many pulleys. The sooner you can get this system interchangeable the better you are off. If you are going to put in motor generator sets for your direct current motors you might as well carry that system throughout your shop, provided changing to the alternating current for your tools does not possess to your mind some advantage that sticking consistently to a given plan does not. This is a matter that is essentially practical to us, and one that goes very deeply into shop economics ; it is a matter in which the personal equation is very largely involved ; you have got to study your men and you have got to give them something they thoroughly understand. Your system has got to be fool proof. The superintendents that are putting it in are not accustomed to it ; you give them a complex proposition and it stops them. I know of a case to-day of a very intelligent shop superintendent who is devoting his present time to studying electricity with us and he came back with questions like this : "Well, you have a compound wound motor and you have a series motor and you have a shunt wound motor ?" "Yes."

"Does it make any difference whether you put your series field on one side of the armature or on the other ?" "No."

"Does it make any difference whether you get your shunt field in this way or that way ?" "Oh yes."

"You have a compound wound generator ?" "Yes."

"You have shunt wound generators ?" "Sometimes."

"What is the difference between a compound wound generator and a compound wound motor ?" "No difference."

"Always wound the same ?" Not always, because you may have a differentially wound motor or an accumulative motor."

"What is a differentially wound compound motor ?" "It is very simple if you only go down to the basis of the thing."

"By the bye, where does the induction motor come in ?" "That is an entirely different kind of a motor."

"How many different kinds are there that you have forgotten to tell me about ?" "I think that is about all."

"You don't make compound wound induction motors ?" "Oh no."

"Let us see, we were talking about—" "We were talking about a differentially wound and an accumulatively wound compound motor."

"Well," he says, "there is an awful lot about this thing that I didn't know about." And thus they go on. (Laughter)

Some of us have had experience with printers and a great many of us have had experience with street car operators. I am very sure some of the gentlemen here will bear me out in saying that we have to make the installation as simple as we can and follow the rule of the French woman who said, if she had more time she would write a shorter letter.

Mr. Higman : As a bye-stander viewing this matter outside of actual practice, I would say that the question which most concerns the central station manager is not what may be the best practice in large machine shops, but how best to meet the demands of small users of power. The question of power in a large factory is one of minor importance, amounting as Mr. Lozier tells us to only three or four per cent. of the total cost of the equipment. Nineteen-twentieths of our central stations in Canada generate only alternating currents and the question of how best to meet the demands of all services from one set of generating units is of first-class importance. What would you recommend ? A constant speed induction motor with mechanical regulation, or the more flexible direct current motor, and if the latter what is the best method of transformation ? Something along this line would be helpful to us all.

Mr. Toltz : I have been very much interested in the paper relating to the variable speed motor, read by Mr. Lozier, but to determine if such motor should be used on a tool, I would advise that every case in every shop should be studied by itself. Being a railroad man, I can speak only about railroad shops. There is no doubt that the variable speed D. C. motor has great advantages, but as most of the tools in a railroad repair shop are run to a constant speeds for the simple reason that each machine is assigned to a certain class of work, which it will do year in and year out, the A. C. constant speed motor is much preferred. To make clear this assertion, reference is made to tools like a tire lathe. Each important shop has from 4 to 8 of this kind of machine, but each one will turn a certain size of tire. For instance, a 96″ wheel lathe will turn tires from 86″ to 90″; a 42″ wheel lathe will turn the tender wheels, which are generally from 36″ to 40″ in diameter, and as each machine has a cone the speeds could be varied according to the softness of the metal which has to be turned. The same can be said of planers, slotters and shapers. There are, of course, tools for which variable speed of wide range should be provided. Reference is made to boring mills, especially on which tires of 86″ in diameter are bored and at the same time the hub of the centre of a driving wheel has to be bored out; this hub being about the diameter of 10″ to 14″. In laylng out tools for the C. P. R. shop at Montreal, which will have an aggregate horse power of 5,400, most of the tools were grouped and all heavy tools, especially under the service cranes, are driven by individual motors. Out of this whole aggregate of 5,400 horse power, tools to the amount of only 150 horse power will be driven by variable speed motors. All group and individual tools will have the A. C. constant speed motor, while for the variable speed tools the D. C. motors of special type will be applied. This, of course, necessitates a motor generator set to convert the A. C. current into D. C. current. In regard to the speed which a tool should run to work a certain kind of metal, the operator of the tool should not be the one to determine such speeds. Herein I disagree with Mr. Lozier and Mr. Cooper. Each well regulated shop should have a shop system whereby the operator of the tool simply has to follow instructions which are given him on the card describing the piece of work. He will find on this card which cone or back gear he has to use if the tool is run by a constant speed motor either individually or in group, or in case it is driven by the variable speed D.C. motor, the notch in the controller to be used is recorded. Such shop system at the same time is a check on the workmen because the speed and the cut being known the time can be easily computed in which such work should be done. I admit that their is a difference between a railroad repair shop and a manufacturing shop because in the latter, a hundred different kinds of work may be done on one kind of machine, but such is not the case in the railroad shop and I am simply speaking from that standpoint.

The President called for the reports of any committees which had not reported on Wednesday.

Mr. A. A. Wright presented the report of the Committee on Statistics, and said : Just before commencing to read this report I may say that compiling statistics is rather a difficult task I can assure you ; when you have once tackled the problem you will find how difficult it is. We found it was almost impossible to get the information which we wanted from the parties who possessed it. They seemed to think they had enough to do to mind their own business and in fact they frequently told us that ; the consequence was we took it for granted that they meant we were not minding ours and we had to drop them and proceed in the best manner that we could. However, such information as we were able to glean we are glad to present to you in this concise form.

REPORT OF COMMITTEE ON STATISTICS.

To the Canadian Electrical Association :

Your committee on Data appointed at the last annual convention of this Association beg leave to present the following report :

1st. We find it very difficult to get any very reliable information concerning the electrical industries in Canada in their earliest growth.

We can however confidently lay the following limited information before you, fully believing that it will be found to be fairly reliable on those points that your committee have taken up.

You will please bear in mind that this statement does not include the large number of isolated plants, i. e. private lights where commercial enterprises have electrical plants of their own doing their own lighting.

Your Committee found it impossible to get any reliable information concerning these and consequently the number of arc and incandescent lights given in the accompanying table should be increased to a very considerable extent but just what percentage of increase should be added we do not care to undertake to say and consequently we have confined ourselves to those companies which are doing business under a license from the government.

Provinces	1898				1899				1900				1901				1902			
	No. of Companies	No. of Lamps.		Registration Fees Paid.	No. of Companies	No. of Lamps.		Registration Fees Paid.	No. of Companies.	No. of Lamps.		Registration Fees Paid.	No. of Companies.	No. of Lamps.		Registration Fees Paid.	No. of Companies.	No. of Lamps.		Registration Fees Paid.
		Arcs.	Incan desc't			Arcs.	Incan-desc't.			Arcs.	Incan desc't			Arcs.	Incan-desc t.			Arcs.	Incan-desc t.	
Ontario	165	6,185	238,161	$2,295	172	6,297	271,2[illegible]	$2,495	187	6,577	334,153	$2,760	196	6,830	384,496	$2,905	198	7,[illegible]30	[illegible]	$3,0[illegible]2
Quebec	40	[illegible]	131,101	625	44	3,060	163,014	720	49	1,096	214,362	777	50	4,118	270,120	782	52	3,605	340,1[illegible]	[illegible]50
Nova Scotia	20	480	28,[illegible]	310	23	401	33,109	320	23	3[illegible]2	38,725	350	21	373	39,516	315	24	109	4[illegible],475	37[illegible]
New Brunswick	9	411	13,500	150	10	159	15,101	175	11	657	15,747	200	11	691	18,131	185	11	6[illegible]	21,[illegible]5	185
Manitoba	6	162	13,800	120	6	155	13,100	120	6	177	21,359	100	6	22	19,250	275	6	43	[illegible]35	29[illegible]
British Columbia	11	457	28,800	200	12	477	39,578	210	13	587	40,783	250	14	643	68,763	275	16	770	[illegible],13[illegible]	2[illegible]0
Prince Edward Island	3	90	4,780	45	3	87	6,325	60	3	87	6,[illegible]30	60	3	92	9,526	60	3	87	11,330	60
The Territories	5	25	4,6[illegible]	65	5	26	5,105	80	5	34	5,700	95	5	31	5,785		5	31	[illegible],051	
Totals	259	10,389	463,615	3,810	275	10,662	546,642	4,170	297	11,587	683,250	4,592	306	12,800	815,676	4,797	315	12,874	995,056	507.500

From this table we are enabled to glean the following information :—

That the number of companies doing business in electricity in connection with lighting has increased from 259 in 1898 to 315 in 1902.

The number of arc lights in use has increased during the same period from 10.389 to 12.874, while the number of incandescent lights have grown during the same length of time from 463,615 to 995,056 or more than doubled in number in 4 years.

In the matter of incandescent lighting it will be noticed that every province has made substantial and most creditable progress and we have no doubt that when the present year shall have closed the progress will be found to be equally great.

Your committee would also have been pleased, if they had been able, to give you some reliable information with regard to the growth of enclosed arc lighting, but the means of obtaining this information has been so limited that we have been obliged to omit this subject.

We might also mention that of the large Canadian cities in which electric lighting is carried on Montreal stands first with reference to the number of its lights.

Montreal having	2,474	Arc Lights	and	184,978	Incan.
Toronto comes next with	1,672	"	"	100,000	"
Ottawa has	650	"	"	93,207	"
Hamilton has	600	"	"	32,100	"
While Quebec has	500	"	"	40,000	"

One point to which we would respectfully draw your attention is the fact that in the Province of Ontario at last municipal ownership seems to have taken a pretty firm hold, no less than 44 towns owning their electrical systems as you will see by the following list. It is not our duty to enquire into the desirability or undesirability of municipalities going into the business of furnishing light and power. We merely have to do with the presenting of such facts as we can glean on this subject and allow others to undertake the discussion of results.

The following places in Ontario have municipally managed electrical plants to which are attached in most cases the year in which they assumed control.

1. Almonte
2. Acton
3. Alexandria 1895
4. Aylmer 1900
5. Barrie 1899
6. Brockville 1900
7. Beeton
8. Bracebridge 1894
9. Blenheim
10. Bothwell
11. Campbellford 1889
12. Chatham 1898
13. Collingwood 1899
14. Dundalk
15. Dresden
16. Fort William 1897
17. Fort Francis
18. Goderich 1889
19. Guelph 1903
20. Hespeler
21. Huntsville 1897
22. Iroquois 1901
23. Kincardine 1894
24. Mitchell 1888
25. Markham
26. Morrisburgh 1901
27. Niagara
28. Niagara Falls 1889
29. Newmarket 1896
30. Orillia 1887, 1901
31. Oakville
32. Parry Sound 1901
33. Paris 1901
34. Picton 1890
35. Prescott 1899
36. Port Arthur
37. Palmerston
38. St. Marys 1896
39. Sudbury 1895
40. Toronto Junction 1891
41. Trenton 1895
42. Thorold
43. Weston
44. Woodstock

Of the other provinces and territories we have not been able to glean sufficiently reliable information to guarantee us in tabulating them as we have Ontario.

It is also pertinent to add that the towns of Perth, Listowel, Ingersoll, Wiarton, Renfrew and others are at present arranging to purchase the plants in their respective localities.

A. A. WRIGHT, Chairman
K. B. THORNTON
D. R. STREET

Mr. Lozier moved that the report be accepted, with thanks for the very careful manner in which it had been prepared.

Mr. Higman : Before the motion is adopted I would like to correct the impression that these companies are doing business under a "license" from the Government. That statement might convey a wrong impression. The companies are doing business under charters obtained from the legislatures and letters patent, and the Department could not interfere with them. The Inspection Act requires that companies shall register, and pay a registration fee to help meet the expenses under the Act. Registration is also necessary for purposes of statistics; but it is in no sense a license.

Mr. A. A. Wright : I cannot understand the honorable gentleman when he says they are not licensed. What do I pay this money for ? I think I pay every year for a license. I notice that in the year 1902 the companies doing business in the Dominion of Canada paid into the Government $5,075. Now what did they pay that money for? I have always understood that we were paying that money for a license. We send our money down to the Government and we get a receipt back which I have always considered was a license.

You can call it whatever you like, I know we pay the money. If we didn't pay that money I suppose they would want to know why this is thusly.

Mr. Higman : The registration fee is part of the sum necessary for carrying on the work of inspection. The inspection fees for meters alone would not be sufficient. We had expensive Standards to install and other work to do and it was thought that a small registration fee levied on every company doing business would help the work along. By means of registration we have a complete list of all companies doing business. The word license, if used, is incorrectly used.

Mr. A. A. Wright : (W)right may be wrong, but I am under the impression that when we get our printed notices from the Collector of Inland Revenue that "license" is the identical word used. This I may be mistaken in ; I will look that up.

Mr. Higman : My friend is always (W)right.

Mr. Saxby : I believe that during last year the Government in connection with a great many of the smaller plants reduced the fee from $25 to $10. I know where we paid $25, only last July we only had to pay $10. They have made a reduction down to a certain number of lights.

Mr. Higman : The policy of the Government in this respect is that as the fees for the inspection of meters increase the registration fees will be decreased. At present the fee for all companies having an installation of five hundred incandescent lamps and under is five dollars ($5.00) a year, all companies having an installation of over five hundred and not exceeding two thousand incandescent lamps, a fee of ten dollars ($10.00) a year, and all companies having an installation in excess of two thousand incandescent lamps, a fee of twenty-five dollars ($25.00) a year.

The President : This report will be received and adopted. I understand the committee to select the standing committees is ready to present an interim report.

Mr. Yule presented the interim report as follows :

REPORT OF STRIKING COMMITTEE.

TORONTO, June 11th, 1903.

B. F. Reesor, Esq., President C.E.A.

" The undersigned appointed by you as a Striking Committee beg to call your attention to article 19 of the new constitution now in force which differs somewhat from the former constitution as regards special committees.

(a) You will find that the general meeting must first decide by resolution what committees are necessary or desired for the coming year.

(b) That the chairman must then appoint a committee of five active members to strike such committees."

Respectfully submitted,

JNO. YULE.

The President : That being so it will be necessary to pass a resolution at this stage to determine what committees you wish appointed. The committees appointed last year were : Legislation for Ontario and Quebec ; Statistics ; Arc Light Rating ; Standardization of Accounts ; and to confer with the Fire Underwriters. If you do not require that many committees it would be proper now to pass a resolution.

Mr. Dion : I will move the appointment of a Committee on Legislation for Ontario and for Quebec and a Committee on Statistics. My intention was to leave out the Committee on Statistics as well as the other committees which are not now doing any active work, but from the report which has just been read I find that for the first time in ten years the Committee on Statistics has given signs of life ; therefore I will give them another chance.

Mr. A. A. Wright : Hear ! Hear !

Mr. Dion : I think those three committees constitute about all that is necessary at present. Should any special matter come up during this meeting to make it advisable to elect other special committees, we can do so ; but at the present time I fail to see any necessity for any of the other committees which have remained on from year to year and are not doing any active work.

Mr. Yule : I second the motion.

The President put the motion, which, on a vote being taken was declared carried.

The President named Messrs. Dean, Williams, Holman, Henderson and Fisk as a select committee of five to strike the standing committees, and stated that it would be necessary for them to report at the next session.

Mr. Yule moved, seconded by Mr. Hunt, that the report of the Committee on Legislation for Ontario be now taken up.

Mr. Yule : I suppose the only feature in this report we have to discuss this morning is one I called attention to yesterday, that owing to the amount of work to be done and the help that had to be engaged the committee find themselves considerably short of funds. The amount of the accounts that we incurred from year to year, from 1898 until now, has looked large. We have found it necessary to engage counsel and solicitors for any help we required. The agitation to get protection for the companies was started in 1897 and continued until 1899, when we succeeded in getting passed through the Legislature what is now generally known as the Conmee Bill. There was quite a large expense, but each year since that time we have been more or less put to the necessity of defending and keeping these amendments on the Statute. To do that cost money. In the first part of the campaign the companies contributed fairly liberally and we were also helped, I am very glad to say, by two manufacturing firms, the Packard Company, of St. Catherines, and the then Royal Electric Company, of Montreal. They helped us out of our difficulties in 1899. Since that time we have managed to go along very nicely and pay our way, but this year the fight was so strong and vigorous we had scarcely time to breathe and it may seem to you peculiar when I tell you lawyers were scarce this year ; we could not get the lawyers we wanted ; there were investigations going on in Ontario and there were railway bills in Ottawa, and a great many different things that took the best talent and the talent we wanted to secure ; the result was we had to divide up the work and secure men for limited periods to do the work that we thought necessary. Our accounts are rather large ; they amount to $1,609.85. Our excuse for incurring those accounts is that we have been successful. We have accomplished what we set out to accomplish and we have done good work for the companies in this province. We have saved for them, I am safe in saying, millions of dallars. Another thing that has weakened us, gentlemen, is that the companies are gradually going over to the municipalities ; they are being gradually bought out ; we are being weakened in that way ; some of our strongest supporters have gone over, Berlin, Brockville, Owen Sound, Guelph and Kingston, etc. We managed to collect this year something like $855.76 and have further promises ; the committee have been hard at work since we met here trying to get extra subscriptions from those who have already contributed and from those who have not contributed, and have met with fairly good success, but are still short about $500. The committee have looked into the finances of the Association and seeing that all the members, especially the men who represent companies, have been largely benefitted and protected by our work, consider that they ought to vote a sum of $300 from the funds of the Association to help us out. You will see if we are going to come to trouble now the whole thing goes to pieces and the companies would be left to individually look after their own interests. That might be a better method ; it might be better to change over in that way, it is for this meeting to decide, or to go on in the way we have been going. I would also call your attention to this, that the members of the committee have paid their own expenses. I have been in Toronto three or four days a week from one month to two months each year since 1898, and it never cost this Association or any company a cent ; my expenses were not taken out of the contributions made by the companies, so that any subscriptions paid were devoted entirely to the legitimate expenses, legal help, counsel and assistance of that kind. There was no member of the committee who received a single cent towards his expenses and under those conditions I think it is only fair, as we have got into this difficulty now, that the Association at large should come to our aid, and to bring out the feeling of the meeting I would move that the Association vote $300 towards liquidating the accounts of the Legislation Committee of Ontario.

Mr. Hunt : I have been on this Legislative Committee for a year or two and I know something about the way the moneys have been expended, and there is nothing secret about it. If any gentleman present who has subscribed wishes to come forward after the meeting is over and look over the accounts he is quite at liberty to do so, but I want to impress upon you the fact, as Mr. Yule has said, there is not one cent of the personal expense of any member of that committee that has been taken out of the funds subscribed for legislation. I don't know that there is any particular praise due to us for it, as we simply were doing our duty and and in protecting our own interests we were protecting yours as well. I think it is quite within our rights, and in fact I think this meeting should vote some funds towards helping to pay the legislation accounts which are now due, and I think this Association would do well to give this $300 for whlch Mr. Yule has asked. I have pleasure in seconding the motion.

Mr. A. A. Wright : I would like to say one word in support of this resolution. There is no doubt that this Legislation Committee have done exceedingly good work during the past. I believe everything my friend Mr. Yule has said, that they must hve saved the companies in this province at least a million of dollars, if not more, and I do not see anything to hinder this Association as a whole doing something in aid of this work which has been undertaken, and, as our friend Mr. Yule has said, carried to a successful issue. I think there one thing that the last speaker rather overlooked, and I do not think he will blame me or find fault with me when I call his attention to it ; I don't think he will object to it ; he said there was no reason why any one who had given to this fund should not come forward and see that the amount they had given was actually there and accounted for. I don't see that there can be any reason why those who have not given cannot come forward and see the amounts which they have given in support of this good work. It seems to me that there are a large number of companies doing business in this country of ours that one of these days, if this Conmee Bill is thrown out, will waken up some fine morning and find their stock which now is valued at $7,000 will be worthless. I do not see why, under the existing circumstances, those who have given nothing for the advantages gained except their membership fee should not contribute a small proportion of those membership fees out of the money we have in our treasury towards this good work.

The President put the motion, which, on a vote having been taken, was declared carried.

The President called upon Mr. G. U. G. Holman, of Quebec, to read his paper on "Some Points Relating to Submarine Power Cables."

Mr. Holman : With the consent of the President and the gentlemen present, I will ask Mr. A. C. Read, of the Canadian Electric Light Company, to read this paper for me.

Mr. Read : The paper, which is only a short one, is to bring forward the work of submarine cables which we have had some experience in, and if there are others contemplating this kind of work it will bring out a few points that you would like to hear about. The paper as read is printed elsewhere.

Mr. Holman : With reference to the type of cable we would use, as to whether we would use the paper rather than the rubber, I might say that owing to the indentations which we discovered by soundings in the bottom or bed of the river, as well as the supposed mechanical movement of that cable by the tide flow of the water, we thought it would be very injudicious to use a lead covered cable using paper as the insulation because if a break in the lead covered cable would ensue the cable would be absolutely worthless.

Mr. Smith : Do I understand Mr. Holman to say it is a lead cable.

Mr. Holman : There is no lead in the cable that we are actually using. The paper covered lead cable wonld have been less expensive, first cost, than a rubber covered cable armored with spirally wound heavy steel galvanized wire.

Mr. Read : Mr. Holman was speaking about the paper covered cable, and if a break occurring that way, the water would get in and spoil it. With the rubber covered cable we had a break and the water got in; we commenced to cut back, but we found that was useless, so we went to work and joined the cable up as well as we could and we found the water that did get in had no effect at all. We thought that perhaps if there was any heat in the conductor, and any of that water was there still, it would move up towards the shore end and disperse gradually.

Mr. Lambe : Are we to understand from Mr. Holman then that he would consider it advisable to use lead for the work?

Mr. Holman : Inadvisable to use lead with a rubber covered cable ; in other words, it is an extra precaution which our experience has shown not worthy of being paid for.

Mr. Lambe : It would be interesting to learn how you protect the ends ? What sort of cable house you use ?

Mr. Holman : We have laid that cable into the shore and brought the cable up to the best natural point in the shore, and fortunately we were very favorably placed with regard to a feature that happened to be on both sides of the river, but the worst ice condition which we at the time considered would be possible was on the south shore, the Levis shore, and there is where we took our extra precautions in bringing in the shore end ; we brought it up in a space between two contiguous or adjacent walls, or a dock-like space, and in through the crib work, removing some of the stones for that purpose, and anchored it by means of small three quarter inch chains tied aronnd the cable and wrapped around the crib work and then bringing the cable up through and attaching our bell and we brought the bell up inside of a little cable box. You cannot get the cable box too large ; that is my experience. The first ones we had were, I think, altogether too small. It is advisable to have switches between the terminal ends of each of the wires brought out from the bell and lightning arresters.

Mr. Lambe : What do you say as to the cable versus aerial lines, if you can get up an aerial line without having the strands too large ?

Mr. Holman : By all means do it.

Mr. Black : I would like to ask when this cable is taken up for repairs if it shows much mechanical wear.

Mr. Holman : It apparently shows no wear. There were several places where the outer steel covering was apparently rubbed, but we noticed the same thing at places where it could not have rubbed, showing that it probably was caused during shipment. The cable No. 1 was shipped to us coiled on a flat car in the form of the figure "8" and the movement up and down between the sides of the posts on a flat car would be more likely to cause the slight disappearance of a portion of the outer covering on some of the steel wires.

Mr. Black : How long has it been down ?

Mr. Holman : It was placed in the river in December, 1901, and we had our breakdown in October, 1902. As long as the cable had been down three months from the beginning, in other words, in the month of February or March, it was deemed by myself and Mr. L. R. Clarke, of the Safety Insulated Wire and Cable Company, of New York, that any cable standing for three months under those conditions was a sound cable electrically. But, as you notice in the paper, it was a mistake in, if you might call it, mechanical design to place little wires that might be broken and did break and cause the things we have seen, the erosion or deterioration of the contiguous insulations.

Mr. Gossler : I would like to ask if it is in order at some later time in this convention to re-open the discussion on Mr. Lozier's paper. The paper is well worthy of more discussion than it was given this morning and I know in some instances the remarks were merely preliminary and if it is in order I would like to have a time appointed when this paper could receive more consideration. I notice later on there is a paper which I have not had an opportunity to read, on " Single phase alternating motors, as a means of Increasing Station Earnings." Would it be in order to discuss Mr. Lozier's paper after that or in connection with that paper ? Certainly much of the information we are to get from the papers presented before the Association is expected to be brought out in discussion and I for one would be very sorry to see this paper on variable speed motors passed over with so little discussion. There are a great many here competent to speak on this subject, both men familiar with machine design and also operating men who desire to increase their output.

The President : I think opportunity probably will be given this afternoon sometime. At any rate it is quite in order to have the discussion on the paper re-opened at some future time. I do not know at what time it would be most suitable.

Mr. Higman : We might take up Mr. Gossler's suggestion and bring it in under the discussion on this other paper.

Mr. Dion : If the discussion of Mr. Holman's paper is finished we have at least half an hour or more to dispose of before we adjourn. It was intended to take up the Question Box, but this is as broad as it is long. You take this time up with something else and bring in the Question Box later on. We could have this discussion on Mr. Lozier's paper or in connection with the other paper on motors which is to be read. Perhaps we had better take it up now, as the gentlemen who intend to take part in the discussion may not be here later.

Mr. Hunt : Is Mr. Layman here to read his paper ? It might be taken up at once.

The President : Mr. Russell, who is to read Mr. Layman's paper, says he did not expect this paper to come up out of the regular order, and he is not quite prepared.

Mr. Dion moved, seconded by Mr. Gossler, that the discussion on Mr. Lozier's paper be now re-opened. Carried.

Mr Gossler : Mr. Chairman, to open the discussion, I will again emphasize the point mentioned in Mr. Lozier's paper, of working every machine tool in a shop at its highest output. I will not undertake to discuss this paper from a machine design standpoint, but from the operating point of view. Working every machine in a shop at its highest output, of course, gives a more csnstant day load which we are all after, and it will enable us to extend the idea of selling power on a limited basis which permits of more over-selling of power than any other system that is within my knowledge. We have connected with the system with which I am associated, between seven and ten thousand h. p. which is served on the limited basis; that is, we have seven to ten thousand h. p. which from the 15th September to the 15th March of each year, is discontinued at 4 o'clock and is not used again until 7 o'clock p. m., that is, none of that seven thousand to ten thousand h. p. is used from 4 to 7 o'clock between the 15th September and 15 March of each year. Of course, it is obvious what is to be gained by that; it permits of the overselling of power for lighting, and also permits of quoting prices for power which cannot be competed with by steam. While the power service is limited, the number of factory hours per annum is not reduced ; that is gotten around by reducing the time taken for luncheon and also by starting a half or quarter of an hour earlier in the winter. By this means, it is possible to get a more constant day load for the station, and by working the machines at their highest output continually, will permit of the extension of this idea of overselling power. That is one of the points I wanted to bring out in connection with this matter.

Mr. Holman : How does the shop workman take the innovation of the use of tools that will get out more than the regulation amount of work ?

Mr. Lozier : The shop workman is a peculiar kind of animal, he is worse than a horse ; he shies and backs and wants to be fed and you have to handle him very carefully, but it is being done very successfully and it is being done in a very practical manner. I don't know perhaps of a better illustration of that than right here, if you want to have a pitcher of ice water in a hurry, you give the bell boy an extra quarter of a dollar and he hustles it to you. The system that is being most commonly used in the shops is to tip the workman. We don't say anything about piece work or contract work or anything about any of these new fangled works, we just go to a man and say, look here Jack, here is a piece of machiney to be machined and the way to machine is in just this sort of a way ; if you want a tool don't go and grind it yourself,you push the button alongside of your machine, there is an indicator over there, a boy come up and he goes to the tool room and he gets the tool that the engineering foreman has marked on the method card to be used ; if the tool gets dull send and get another. This work can be machined in just a certain length of time ; it takes about fifteen minutes for crane service, it takes about twenty minuter to handle the work, to set it, and about ten minutes to get ready and we have got a cylinder, the surface of which has got to be machined, and the area to be travelled by the tool at a certain rate with a certain feed is so long, and this tool can run at a certain cutting speed ; this thing is all figured out for you ; you don't have to worry about it. If anything goes wrong drop your tool or adjust it, but that surface, theoretically can be covered in a certain length of time at a certain cutting rate. Go ahead and see if you can't do that. If you do we will give you half a dollar as a tip.

"These bonuses run about seventy-five cents a day and any workman can make seventy-five cents a day as a tip in addition to his pay, or if he does better than that time he gets more." Jack says, "that tool is no good." "Never mind, you don't have to worry about that, we will take the responsibility for that." "I never set my work that way." "You try it that way." "It can't be done in that space of time." "You go ahead and try it." "I don't like this business particularly ; I am accustomed to doing things my own way." Then we stand off to one side for a minute and bring in the speed boss ; he takes hold of the work and he gets it through in about 80 per cent. of the time that is allowed Jack to do the work. The man working on the lathe, the fellow on the shaper right back of him and the planer hand, is giving Jack the laugh, and Jack gets down to business and starts in and makes his bonus. When we start, we pick out a pretty good man.

Mr. Saxby : A great deal of what you say is practically true, but there is a very great deal of difference in castings, some are harder and some are softer, and some not annealed very well and I notice some men have better luck with a piece of casting than others ; one man could work up soft castings very successfully and another man hard castings, but put the same two men on different grades of work and they are not equal to it.

Mr. Lozier : I think probably the answer to that proposition lies in two things. I am not very much of a shop man although I had my turn at it, but I think probably some of the gentlemen here can answer that question better than I. There is only one point I would like to bring up and that is this—I gather this from hearing our own shop people talk—it has been the custom in the past to make the patterns pretty close so that you don't have much metal to take off. That system is being abandoned to this extent, that it was found that most of the tools were cutting the scale rather than the metal itself and that the greatest variation was found to be between the different degrees of scale, and we are adopting the practice of being more generous in our allowances and cutting underneath the scale with the tool. Now if that isn't the trouble I believe it is time to get after the foundry and see what the trouble is there if there is a great variation in the quality of the castings.

Mr. Thomson: Have you ever really tried tipping the workman?

Mr. Lozier: Yes, that method is being adopted almost universally and being very successfully applied.

Mr. Thomson: What is the nationality ot your workmen?

Mr. Lozier: We have all kinds of workmen.

Mr. Thomson: I don't think the ordinary working mechanic would accept the tip. (Laughter)

A voice: Well the bonus.

Mr. Scott: The remarks about the tipping of the workmen or what in general covers the same method, the premium system, is one which is interesting in itself and I think it calls attention to a fact in connection with the electrical work, that the electric motor in the machine shop is not only superseding some other form of drive and can not only do its work better than it was done by some other means before, but the motor can do it cheaper, and it is also leading to changes in the construction of the machines themselves; changes in the tool steel; changes in the method of work; changes in the method of paying and even in shop organization and system. With the works with which I am connected, though I am not connected directly with the manufacturing department, the premium system is pretty generally in vogue. That system in its simplest form might be illustrated in this way: Suppose it is found that a piece of work could be done normally in ten hours. That, then, may be taken as a basis. When workmen are hired they are expected to do that much; if they do not do that much they are paid their day's wage anyhow. If they do that much, well and good. If they do more then comes in the bonus or premium. If a man can do his ten hours work in eight hours he received nine hours pay; if he can do it in six hours he will receive eight hours pay for that six hours. In this way the superior workmen has the advantage of making a substantial increase in his wages, while the company gets a much greater out-put from its tools and its factory. This method in one form or another is in actual and successful work in quite a number of places. One point which Mr. Lozier brought out very well in his paper is the real insignificance of the cost of the power itself. I do not recall to a nicety the figures which were published sometime ago with regard to the locomotive works at Philadelphia—these works are very extensive, turning out on the average several locomotives a day—it was found there that of the total cost of production, the cost of power, including the interest on the investments in power plants, the fuel, repairs and all that kind of thing, amounted to in the neighborhood of three per cent. or four per cent. of the total cost. If by even doubling the cost of the power it would be possible to increase the out-put ten per cent. or to make the labor five or ten per cent. more efficient. It would evidently be economy to do so. Coming more to the technical details, Mr. Lozier has taken up the matter of range in speed in motors and has given certain ranges which may in some cases be necessary. He mentions even a range of one to one hundred. While such ranges may occur I take it that they will be the rare exception; in most classes of work the range required even for variable speed work—will be much less than that, and that even where changes in speed are necessary, sometimes a high speed, sometimes a low speed, those changes need not come rapidly. The cases will be very exceptional when it is necessary to run through the whole range of speeds on one piece of work or in a very short time. Where the changes are to be made less seldom, then the mechanical methods which Mr. Lozier has suggested may be used; that is, a change gear or a number of change gears or a cone pulley which would give several speeds by shifting the belt, could be used with a motor which will have a less range of speed, using a moderate range of speed variation with each of the mechanical adjustments. In taking up any new plan the fact must be remembered, as was brought out in discussion, that scarcely ever two kinds of work are alike and the question ought to be taken up in a good broad way. If every machine is going to need speed variation over a wide range, we have one problem. If in a large majority of cases each machine is going to do approximately the same work continuously, turning the same kind of shaft for example, then speed variations to the fine degrees are not so essential, and a method which would allow a selection of either one of several speeds would be satisfactory, possibly one of the methods which has been used in the past employing change gear or cone pulley, by which a number of definite speeds can be obtained. By such means we may be able to cover a great many of the lines of work which are to be done in any specific shop. The problem, therefore, in taking up the question of equipment for a new shop or the re-equipment of an old one will be to determine what machines are to run at approximately constant speed, and could be driven by constant speed motors, or by group driving, which has numerous advantages, and how many machines require the greatest flexibility in motor speed. I take it that in very many kinds of work and in very many shops it will be found that a very considerable portion do not require any very radical change or altered methods of speed driving from those found in a good many cases now. There are machine shops that have a variety of work, which are driven by constant speed motors and have mechanical means of speed change, and, as pointed out in the paper, do not have all the desirable and flexible characteristics that are possessed by the direct current motor in its facility for speed control, yet they are accomplishing the work in a highly satisfactory manner. When we come from the actual conditions in the machine shop to the electric systems we find about as great a variety as there are requirements in the shop itself. I was very much interested not long ago to look through a report which has been made by Dodge & Day, a new firm of young men in Philadelphia, which has given itself the very characteristic title of "Modernizing Engineers." They had made the study of a certain machine shop; they had outlined the different classes of machines and the requirements; what would need constant speed; what would need variable speed over a certain range; what would need variable speed over a wider range. They had then taken up the different electric systems: Here is the alternating current system with constant speed induction motor; here is the Reeves pulley and Evans friction cone, and other methods of getting various speeds from one speed over different ranges; here are direct current motors with variable field, with multi-voltage control and another system with what in general we might term as a combination of the two, that in which certain steps of voltage—maybe two voltages—are employed, and in addition to this the variable field. They had classified all this and made a study of these different methods. Then they returned to the machine shop which they had in hand and selected the general system, which in that specific csse was a direct current system, which they found to be best and then took that particular system and proceeded to assign the motors to the various classes of work. Although I have been giving some attention to this machine shop problem for some time from an electrical standpoint, I must confess it was a revelation to see how much there was in it when both ends of the problem were thus presented together in a broad comprehensive way. The general methods which Mr. Lozier has pointed out possess many characteristics of excellence, but I think we can take this as a general statement, viz, that when we rely on one part of the system for doing the more difficult things we must do it at some sacrifice both in cost and in simplicity and general effectiveness or efficiency of the working. For instance, if we throw variable speed changing into the mechanical operation of the equipment we will find we have more mechanical complication than we would otherwise have. If on the other hand we put it into the electrical apparatus it is natural to suppose that when the mechanical engineer gives up the problem he has been working on for a good while, and has not solved it yet in a fully satisfactory way, and the electrician takes it up, we must expect the electrical machinery must be made at some sacrifice in its simplicity or in its cost; it will probably cost more; you will have to pay for this extra advantage which you cannot have obtained in other ways. We find, then, that there are various different arrangements of the electric system, one with which I am particularly familiar is that in which the direct current motor having a fairly wide variation through changes in its field strength is supplied with two voltages such as those in the Edison direct current system, 110 and 220 volts. This does not give the same number of difference of speed by shifting from one circuit to another that is obtained in the more complete multivoltage system in which there are twice that many voltages available, more or less, but it has certain advantages in the way of simpler circuits and simpler generating equipment and is found to cover quite a wide range of usefulness. There are a number of plants in which both direct and alternating current motors are used, some steam-driven for factories as well as water power plants with long distance transmission where the alternating current is supplied, and it is a choice of either using it immediately, or employing some type of converting apparatus to get it into direct current. There the chief object is to use in the form of alternating current all the available power that can be used to save expense. Where the desirability of using direct current for the variable speed is such as to justify the introduction of converting devices, well and good. Not only is this true in plants which have alternating current plants to begin with as transmission plants, but I know of a number of isolated plants which have been put in where it is a choice of making the direct current the one and only thing or putting in an alternating plant and then adding a rotary converter for that portion of the power which is needed for variable speed and direct current control. For example, in a certain rubber mill where the service was deemed to be very hard and the simplicity of the alternating current induction motor appealed to the engineer who was selecting the apparatus, it was determined to put in alternating generators and run the main part of the power, I think some 2000 h.p. more or less, by alternating current and then transform into direct current, the few hundred horse power they required for that type of work. I have been quite an advocate of the induction motor not because the induction motor is the only thing but because it is a good thing, and I am pleased to take that broader view which recognizes that each type of motor and each system has its own characteristics, and if it can show that it has on the whole the advantage over others for that particular place why it is undoubtedly the thing to use. But having been closely associated with the induction motor particularly, I am very pleased to note one thing this morning. A number of years ago—five or six years ago or longer—when an induction motor was mentioned, the advocates of the induction motor were put in the position of demonstrat- that the induction motor can start itself and will not burn out and will really do the business. This morning it is not some theoretical man who cares about the design of the motor or about something that goes on inside of it, but the men who have been using the motors who have said here in the discussion that of course the induction motor is the thing, it is the right thing to use if we can do so, and where we can't possibly use it then we will take the direct current motor. (Applause).

Mr. Holman: I should like to ask Mr. Lozier if they are adopting for d. c. work 250 volts as their standard in the Bullock Company? The practice was tending at one time to be 500 volts. I should judge from his remarks they are putting it at 250.

Mr. Dion: I thought perhaps Mr. Lozier could answer two questions at the same time. I wanted to ask him another one. I was called away during the reading of his paper and I missed part of it and part of the discussion. I confess I am not familiar with the multi-voltage system of control of motors. I have read something about it, but my mind is not very clear on it at the present time. I wanted to ask him how he obtains his multivoltages? How from a commercial circuit of a given voltage he obtains his different voltages.

Mr. Lozier: To answer Mr. Holman, we are adopting 240 and 250 as the standard voltage. We take that voltage in the so called Bullock System and split it up into 90 and 160 so that the sum of the two is 250, and in that way we have three voltages with three wires; that gives you the standard three wire plan, cut-outs, switches and so forth. It makes one more wire to the wiring system so that it is the same as the common three-wire system, 120 volts on the side, except we split it up so as to get out of it all that there is in it. That is our text, we want to get all there is out of it; we want to get a dollar out of a dollar. As concerns the balancer, they are really remarkably small; the balancer goes something on the system of a life insurance company, who do not expect all of their policy holders are going to die at the same time. Nor do we expect all the motors will get on one side of the system. The motors balance themselves up. The more motors you have on the balancer the smaller the balance need be.

Mr. Hunt moved, seconded by Mr. Gossler, that a vote of thanks be given to Mr. Lozier and to Mr. Holman for the very valuable papers presented by them. Carried.

Mr. Dion: Since the motion was made with reference to the Standing Committees for next year I have had a consultation with a member of the Committee to confer with Underwriters and it has been deemed desirable to continue that committee. Not that there is any immediate need for it, but because need may arise at any moment and we wish to be in a position to call the committee together when this condition arises. I would move, therefore, seconded by Mr. Lozier, that we name a committee to confer with underwriters for the incoming year, in addition to the other committees. Carried.

At 12.40 o'clock p. m., convention adjourned.

AFTERNOON SESSION.

At 2 o'clock p.m. the President in the chair called the convention to order and asked for reports of committees.

Mr. Dion: The committee on striking the standing committees which you have appointed this morning beg to report and recommend the following for the various committees to be elected to-morrow:

Committee on Statistics—A. A. Wright, M. P., Chairman; D. R. Street; J. W. Purcell.

Committee to Confer with Underwriters—P. G. Gossler, Chairman; A. A. Dion; J. J. Wright; G. U. C. Holman; G. M. Wright.

Legislation Committee. For Ontario—Charles B. Hunt, Chairman; A. A. Wright, M. P.; B. F. Reesor; A. A. Dion; W. H. Breithaupt; R. O. McCulloch; J. J. Wright; J. W. Purcell; with power to add to their number. For Quebec—E. A. Evans, Chairman; J. McCarthy; P. G. Gossler; A. Sangster; G. U. G. Holman; with power to add to their number.

On motion the report was received.

Mr. Smith moved, seconded by Mr. Kammerer, the following resolution: This Association learns with deep regret of the serious and long continued illness of Mr. J. J. Wright, the First President of this Association, and begs to extend to him and his family an expression of its sympathy and best wishes for his speedy restoration to perfect health. Carried.

The following resolution was also adopted:

Mr. A. A. Wright: The members of the Canadian Electrical Association having learned with pleasure that it is apparently the intention of the Dominion Government to assist in a liberal and substantial manner the proposed Canadian Arctic Expedition under Capt. I. E. Bernier, it is theretore moved by A. A. Wright and seconded by H. O. Fisk :

"That in the interests ot science, the Canadian Electrical Association, this day assembled in their Annual Convention, approve of the proposed government's assistance to Capt. Bernier, in aid of his purely Canadian Polar Expedition, and heartily recommends the project to public support, and it is furthur moved that Capt. I. E. Bernier be appointed to a life membership in this Association and the Secretary is hereby instructed to forward a copy of this resolution to the Right Hon. Sir Wilfrid Laurier, Premier of the Dominion, to the Hon. Mr. Prefontaine, Minister of Marine and Fisheries, and also to Capt. Bernier."

The President read a letter from the DeForest Wireless Telegraph Company extending an invitation to inspect the method of working the system in Toronto.

The President called upon Mr. W. A. Layman, St. Louis, to read his paper on "Single Phase Alternating Motors as a Means of Increasing Station Earnings."

Mr. Russell : Mr. Layman is unable to be with you and I will endeavor, with your permission, to present the paper, which is printed elsewhere.

The President : In order to facilitate matters I think it would be wise to have the other paper read now and leave the discussion until some other time, and we will have now a paper by Mr. J. W. Farley on "Transformers for High Voltage Transmission Lines," which is printed elsewhere.

The President : Our time is about up. I am sorry we have not time to discuss these papers considerably, but an opportunity will probably be available to-morrow.

The Secretary read a communication from The Cataract Power, Light & Traction Company, of Hamilton, extending an invitation to the Association to hold the next convention in the city of Hamilton, it being now five years since the Association had met there.

Mr. Hunt : These two papers that have just been read, I think, are among the most valuable papers to the majority of the members of the association that have been read. Can these papers be taken up tomorrow at 10 o'clock ?

The President : I think the regular routine being first disposed of, that probably these papers can be taken up and discussed then.

At 3.30 o'clock p. m., on motion, the convention adjourned to Friday morning.

THIRD DAY.

At 10.30 o'clock a.m., the President called the Convention to order and said : Before we go on with the regular business on the programme Mr. Dion has one or two matters he would like to bring up.

Mr. Dion : Mr. Chairman and gentlemen, my position in this Association is that of a general handy man; I pick up the tail ends and bring business before the meeting that other people forget so as to keep things going. I mentioned a matter yesterday in connection with the committee which was appointed for the Standardization of Accounts. That committee was appointed two years ago and they went into the matter very thoroughly, as far as the means at their disposal would allow ; they consulted with a great many people and also obtained information from the National Electric Light Association which had threshed out that matter still more thoroughly ; they had been at it for years and they had adopted a plan which was recommended to its membership. This plan is very fully explained in a pamphlet which was published by that Association and which is entitled "Report of the Committee on Standard System of Accounts for Electric Lighting Companies." This was recommended to that Association and adopted by it. Now, after going into the matter, your committees were forced to the conclusion that they could not improve on that system ; that it met the needs of the companies in Cansda perfectly and just as much as anything else they could think of, and they made a report to this Association that it should adopt the system of the National Electric Light Association and recommend it to its members in Canada. Through want of time this report was not discussed last year ; it was merely laid on the table at the Quebec Convention. Mr. Street, of Ottawa, who was the Chairman of that committee, asked me to bring the matter up here to-day because he could not be present ; Mr. A. A. Wright, of Renfrew, was another member, but he was obliged to leave town this morning. Mr. Street's desire was that I should bring before you a resolution whereby this Association would recommend to its members the use of this system. It does not make it compulsory in any sense—of course we could not do that—but it simply gives the approval of the Association to the system. Now perhaps some of the members are not familiar with this matter, and you will hesitate to take any action on it on that account, but the matter has really been before the Association for two years and we should be in a position to deal with it. There may be no present need of any action of that kind but to those who are on the committee and have given the matter some attention it seemed desirable that some such system should receive the approval of the Association with the idea that in course of time it would lead to a uniform system of accounting on general lines by the different electric lighting companies in Canada. I would move, therefore, seconded by Mr. Williams, that the report of the Committee on Standardization of Accounts laid before the Annual Meeting of this Association be received and adopted and that the standard system of accounts for electric lighting companies adopted and recommended by the National Electric Light Association of the United States be adopted and recommended by the Canadian Electrical Association.

Mr. Evans : In connection with this motion I might mention that I have adopted that system for about fifteen months with most satisfactory results. It is the most satisfactory system I have ever found. If any members here would like to get a copy of the way I have my books ruled I would be very pleased to send a sample sheet on application. The President put the motion, which, on a vote having been taken, was declared carried.

Mr. Dion : Another matter which I desire to bring before you is that of the very generous contribution which was made to the funds of the Association some two years ago by Mr. Frederick Nicholls, on behalf of the Canadian General Electric Company. After the convention which was held in Ottawa, he presented the Association with the sum of $500 which was to be devoted to the purposes of the Association as the Executive Committee might decide. At a meeting of the Executive Committee held in Montreal it was decided that this fund or a portion of it should be devoted to procuring prizes for the best papers to be submitted at the annual meetings or for accounts of original investigations and things of that sort. A sub-committee was appointed to draft rules for awarding these prizes—I was on that committee—and the rules were drafted and sent back to the Executive Committee to be ratified as had been arranged. The Executive Committee did not meet for some time and when it did meet the matter was not taken up. The rules were never ratified. The result was that when the following meeting took place we did not feel at liberty to do anything in the matter because it was still pending. No definite action being taken by the Executive the matter came up again this year and we were in the same position. I took this view that not only were we not authorized to do anything, because the Executive has not finally ratified our rules, but that it would not be wise to grant prizes for papers where papers were contributed so largely by manufacturing companies. I did not think that the manufacturing companies in the preparation of papers were looking for any prizes or direct money rewards and that the idea of awarding prizes was to bring out papers from central station men and young men who would be thus encouraged to make investigations or to report their experiences. My purpose in bringing this before you this morning is to get an expression of opinion from the membership as to how this money had better be used in the interests of the Association, whether the prize idea is a good one and should be carried out or whether it should be dropped and something else adopted instead. A suggestion was made by a member that a considerable number of small prizes should be established to be given for the best answers to questions that would be asked through the "Question Box." Now, I have laid the matter before you. I would like for the direction or guidance of the Executive to hear the opinion of as many members as possible as to what they consider the best use we could put this fund to. I feel it is hardly fair to Mr. Nicholls and the Canadian General Company that this fund should lie there unproductive.

Mr. Hunt : I think that Mr. Dion has perhaps struck the proper key note for the distribution of this money which has been given by Mr. Nicholls. I do not think it is hardly right to give it to the best paper because some of these gentlemen who are closely connected with large companies have opportunities which no station man has. I think it had better be decided —to drop the present plan and put our energies into the question box in some way or other. My idea would be that we carry out the Question Box similar to the way it is done by the National Electric Light Association. The questions are sent in during the months, and Mr. Hartman, the Question Box Editor, sends out to every member of the Association a list of the questions that have been received and he also supplies a blank form, a copy of which I hold in my hand here, which is merely a form upon which the questions are to be answered ; these go back to him and he collects and places them in tabulated form according to the answers that are given. They are then published in a book, a copy of which you have had laid before you at this convention, and certainly it is one of the most valuable collections they have in the National Electric Light Association, and nearly every member who was at the last meeting recognized the fact that there was more information contained in that book than they could get in a library, because it brought up the very difficulties we are having in our business frequently and the remedy for them. I think with Mr. Dion a certain proportion of this money should be set aside for the largest and best number of answers to the questions submitted during the year. It is a matter for the committee to deal with as to the best plan to adopt but I would move that $100 be set aside for prizes, say $50, $30 and $20, to the first, second and third best answers to questions during the year. In the other Association I believe they have a large amount of money available to pay for that sort of thing. But I think we will have to pick out two of the Executive Committee, when they are elected, to assist the Editor or Secretary in getting these matters in shape. I suppose it is sufficient now to vote the money and leave it to a committee to be appointed later on, if that meets with the consent of my seconder.

Mr. Demers : I agree with the gantlemen on my right. A Question Box is something which has always created an interest in a body. The National Association of the United States have questions and have given prizes and medals. Another thing, we must not leave out the education of the young. In my opinion young men who do not belong to the same body, and still at the same time fairly and honestly answer a question and do it correctly, such as we have had done in the States, should also be given a prize. If this money is going to be devoted to one body your body will never grow. You understand there are a great many men, hydraulic engineers, steam engineers and electrical engineers, that do not belong to this body, and they might be able by practical experience to answer questions which we could not. I would like to hear the expression of those present.

Mr. Hunt : The gentleman speaking thinks we exclude anybody from becoming members of this Association. I would be glad to have all these gentlemen join our Association.

Mr. Higman : That would be an inducement to them.

Mr. Gossler : It has been suggested that a great many of the questions will be answered very readily and there should be a portion of that money set aside for prizes and a certain fund to handle this matter during the year. I think that is a very important matter. To circulate questions and get answers and keep this thing going, which will be the most difficult part, some remuneration must be given to somebody to handle it.

Mr. Dion : I think this is a matter that can best be handled by the Executive. If the members here will express themselves so that the Executive will know what the feeling of the Association is, they can arrange the details perhaps better than we can arrange them here. My idea is, as Mr. Gossler has said, that in addition to prizes there should be a fund for expenses, postage, printing, and clerical work, and the Secretary will be in position to know just how much is required. Perhaps it will be sufficient and better for this Association to place on record a resolution to the effect that a Question Box editor should be named by the President or elected at the meeting and that it be a recommendation to the Executive to provide prizes and ways and means and leave the details to the Executive Committee for the coming year. A general resolution at this time would perhaps cover the ground and leave Executive free to act in the matter.

Mr. Hunt : I would move that this meeting approve of the idea of appointing a Question Box editor and that the appointment be left in the hands of the Executive Committee ; and also that $100 be appropriated from Mr. Nicholls' generous fund towards prizes ; and and that the expense of getting forms, postage, etc., be also deducted from this fund.

The Secretary : Let me suggest, I think the resolution that was passed governing the expenditure of that money restricted the amount that could be taken out of the fund each year to $75.

Mr. Dion : I think, Mr. Mortimer, that was done by the Executive Committee. It was done by the Executive Committee with regard to the awarding of prizes, and this was never confirmed, and a motion of this general meeting would override that, any way.

The President : To obviate any difficulty in future it would be perhaps better to have this resolution put in this way, that this resolution will supersede any previous motion.

Mr. Hunt : It would necessarily do so.

Mr. Dion : Supersede any action of the Executive regarding the awarding of prizes.

Mr. Deacon : I would second Mr. Hunt's motion.

The President put the motion, which, on a vote having been taken, was declared carried.

Mr. Hunt moved, duly seconded, that the selection of the place for holding the next convention and the election of officers be now taken up. Carried.

Mr. Hunt : I believe you have an invitation from the City of Hamilton to hold our next annual meeting in Hamilton, and it meets with my approval entirely, as we know Hamilton has made great strides in long distance transmission and also in electric power, railway matters and other things ; also we are near Niagara Falls where large industries are now being built and completed, and I therefore move that the offer of Hamilton be accepted.

Mr. Smith seconded the motion.

Mr. Gossler : If I am not too late, on behalf of the electrical industries of Montreal, I would extend a cordial invitation to the Association to hold their next Convention at Montreal. I think that the interests around Montreal are of sufficient importance to warrant a trip there in themselves and we will do our utmost to give you a good time.

Mr. Dion and Mr. Evans seconded the motion.

Mr. Hunt : May I speak to my motion ? I might say personally I am very favorable towards Montreal, but I do not think that it is entitled to a meeting next year. You will recollect that we went to Kingston and to Ottawa and then to Quebec during the last three years. This is the first meeting that has been held in the west for some time, and I think the west is entitled to one more year before we go east again.

Mr. Dion: In seconding this motion of Mr. Gossler's in favor of Montreal I wish to say that I do not do this because I do not wish to go to Hamilton. I think Hamilton is a good place and I would be very much pleased to attend a convention there, but I think there is some misunderstanding. People who live west of Toronto seem to consider that Toronto is the dividing line between the east and the west. Over in Ottawa we do not look at it in that light; we think some places east of Toronto are in the west; it is a mistake to think when you are going to Ottawa you are going in the east, because while you are going in an easterly direction you are only about the centre of the country. If you are going to say everything east of Toronto is the east it is going to be a little unfair to some of the places in the eastern end. We went to Montreal, from there to Hamilton, from there to Kingston and Ottawa, but if you will remember the circumstances under which we went to Kingston you will understand why we went to Ottawa afterwards; from Ottawa we went to Quebec, and now we come back to Toronto, skipping Montreal. Hamilton got the convention after Montreal, so it would seem to me as a matter of getting its turn that Montreal is entitled to it. Apart from any other attractions, and they are considerable, there is a long transmission line from Shawinigan that I think a great many men in the west, who have no occasion to go to Montreal, would be glad to have an opportunity to see. I would not press this matter, I like to hear the feeling of the members, but I think Montreal is fairly entitled to it.

Mr. Higman: Frequently when I have been in the east, in New Brunswick and Nova Scotia, I have heard it said that the convention is too frequently held in the west and that the distances are so great that those down by the sea are not able to attend; that would include Dalhousie, St. Johns, St. Stephen, Halifax and other places, and I agree with Mr. Dion and Mr. Gossler that we should have the Convention in Montreal next year.

The President: We have before us three invitations, the first one is from St. Louis, the second from Hamilton, and the third from Montreal.

Mr. Dion: There is no motion regarding St. Louis.

The President called for a standing vote on whether Hamilton or Montreal should be selected, and on a vote having been taken, Hamilton was selected as the place for holding the next Convention, twenty-five having voted in favor of Hamilton as against twenty-one in favor of Montreal.

The President: The next meeting place will be Hamilton. (Applause)

ELECTION OF OFFICERS.

The President appointed Messrs. Skidmore and Fisk as scrutineers.

Mr. Hunt: I have very great pleasure, in fact under the circumstances exceedingly great pleasure, in moving that Mr. J. J. Wright, one of our oldest members, who has been deterred by illness from being with us this time, be elected president for the ensuing year.

Mr. Smith: I have pleasure in seconding that, more especially as the Convention is to be in the west, we must have a strong and capable man in the chair.

There being no other nominations, Mr. J. J. Wright was declared elected unanimously to the office of President for the ensuing year. (Applause)

Mr. Dion: I have much pleasure in nominating Mr. K. B. Thornton, of Montreal, for the office of First Vice-President.

There being no other nominations Mr. Thornton was declared elected unanimously to the office of First Vice-President.

Mr. Smith nominated Mr. A. A. Wright, M. P., Renfrew, as Second Vice-president.

There being no other nominations Mr. Wright was declared elected unanimously to the office of Second Vice-President.

Mr. Smith nominated Mr. C. H. Mortimer as Secretary-Treasurer.

There being no other nominations Mr. Mortimer was declared elected unanimously to the office of Secretary-Treasurer.

Mr. Smith: Last year I think we voted our efficient Secretary-Treasurer the magnificent sum of $125 for his services during the year. I would suggest this year we make it $150,—it is a growing time—a basis of fifty cents a day for every working day.

Mr. Thomson: I second that.

The President put the motion, which, on vote having been taken, was declared carried.

Executive Committee: Five members re-elected: Messrs. P. G. Gossler, A. A. Dion, John Yule, Gordon Henderson and A. B. Smith.

The President called for nominations for five new members to be elected to the Executive Committee.

Mr. Smith nominated J. W. Purcell, Walkerville.
Mr. Higman nominated H. O. Fisk, Peterboro.
Mr. Hunt nominated J. A. Kammerer, Toronto.
Mr. Thomson nominated C. B. Hunt, London.
Mr. Higman nominated B. F. Reesor, Lindsay.
Mr. Pratt nominated J. E. Skidmore, Cobourg.
Mr. Evans nominated C. K. Greene, Hamilton.
Mr. Dion nominated E. A. Evans, Quebec, and A. Sangster, Sherbrooke.

Mr. Evans: While the ballot is being counted I think we might with your permission move votes of thanks to the various committees and those who have done so much to entertain us. If you will therefore allow me, I take very great pleasure in moving a vote of thanks to the Canada Foundry Company, not only for the enjoyable ride they gave us to their works, but also for the pleasure we had in being allowed the opportunity of visiting those works. Personally, I am very much interested in that kind of work, and I was very much interested in seeing the large development which undoubtedly is taking place there and will continue to take place. I would move, therefore, that a hearty vote of thanks be tendered to the Canada Foundry Company and that the Secretary transmit the same.

Mr. Wyley: I second that. Carried with applause.

Mr. Dion: I beg to move, seconded by Mr. Williams, a cordial vote of thanks to the Canadian General Electric Company for providing the tally-ho drive for the members, and for other courtesies. Carried with applause.

The President declared, as a result of the ballot taken, the following five new members elected to the Executive Committee: Messrs. B. F. Reesor, C. K. Greene, C. B. Hunt, J. A. Kammerer, and H. O. Fisk.

Mr. Smith moved, seconded by Mr. Gossler, that the recommendation brought in by the Select Committee in regard to the standing committees be adopted. Carried.

Mr. Smith: I will ask, Mr. President, that you vacate the chair.

The President vacated the chair. Mr. C. B. Hunt in the chair.

Mr. Purcell: Mr. Chairman, and gentlemen, I wish to move a vote of thanks to the retiring President, Mr. Reesor, for his very efficient occupation of the chair and his arduous work not only in that chair but on the Executive Committee. He is one of the hard working men of the Association, and has, as long as I have been attending it, been very active in performing his duties in connection with that committee as well as the other things that are for the interest and good of the Association. I am not an orator, consequently I will leave it to some other member who might second my motion to enlarge on it a little.

Mr. Holman: I didn't understand particularly that it was necessary, in order to have the motion seconded, to enlarge upon the value of the past president to the Association, not only in the past year but in previous years, but as you desire a few words I have said them and I second the motion.

Mr. Hunt: Gentlemen, I can assure you it gives me great pleasure in putting this resolution before you.

I have known Mr. Reesor personally myself for a great number of years and a larger-hearted gentleman I have never met, and I think we have all found him the same way. (Here, here.) It gives me great pleasure to put this motion.

The motion was carried amid applause, followed by the singing of "For He's a Jolly Good Fellow" and the giving of three cheers and a tiger for Mr. Reesor.

Mr. Hunt : Mr. Reesor, I have pleasure in tendering you the hearty vote of thanks which has just been passed by this Association for your services during the past year, and we have voted you a jolly good fellow.

Mr. Reesor : Mr. Chairman and gentlemen, I feel very keenly the honor you have done me in voting this expression of your good feeling towards me ; I felt very keenly as well at being elected a year ago to the office of President of this Association ; I think it is an honor to whoever may occupy that chair ; and if I have done anything during the past year or years that I have belonged to the Association, I only feel I am doing the duty that I owe to the Association and to the company which I represent, and I do not think that I am entitled to all the praise that has been showered on me. I feel my inability many times and my weakness in getting up and saying anything. I am not a speaker, as you can all see with half an eye ; I am like the boy who said he was filled with feelings too full for utterance and other things. I must thank you again and thank the Association and the Executive for the way they have helped me carry out my duties while occupying the office of president. I again thank you for the honor you did me in passing this vote of thanks. (Applause).

Mr. Hunt left the chair, Mr. Reesor resuming.

Mr. Saxby : I think it is only fitting that we should pass a vote of thanks to the Local Committee for their untiring efforts to make the Thirteenth Annual Convention of the Canadian Electrical Association the success it has been.

Mr. Gossler seconded the motion.

The President put the motion, which was carried.

The President conveyed the vote of thanks to the Chairman and Local Committee.

Mr. Smith : I was the Chairman of that committee, but they say the most successful business man is the man that gets the other man to do the work. I have succeeded beautifully and we will hear from Mr. Campbell.

Mr. Campbell : I was simply going to make the remark that I wasn't chairman of that committee when you addressed your attentions to me. I certainly, on behalf of the Local Committee, accept very kindly your expressions of pleasure and appreciation of the entertainment provided. I felt myself somewhat at a loss so far as any energies I have exerted in the matter are concerned, to know what was best to do ; at the same time the committee and myself are pleased to learn you have enjoyed yourselves and that what we have done for you has been appreciated. I thank you very much. (Applause.)

The President : I think that finishes the business so far as I am concerned, and I would ask Messrs Smith and Hunt to be present you with new President, Mr. J. J. Wright, by proxy. I will ask them to conduct Mr. Higman to the chair and Mr. Higman will preside over the meeting to its conclusion. (Applause).

Messrs. Smith and Hunt conducted Mr. Higman to the chair amid applause.

Mr. Higman : Gentlemen, this is a somewhat extraordinary proceeding, but it would be discourteous on my part to refuse ; and on behalf of my very dear friend, Mr. Wright, whose illness I deeply regret, and whose election I am just as well pleased as any one in this room, I accept the position. I have been on the Executive ten years and have endeavored when opportunity offered to do what I could for the Association. I found, however, during the past year that it was not possible, in attending to my other duties, to be present at any of the Executive meetings and because of this I had determined to retire. It does not mean, of course, that any little effort I have been able to make on behalf of this Association in the past will not be made in the future. I shall be very pleased indeed to do all I can to help the Association along. I think a desire has been expressed that something further should be said in regard to the two papers that were read yesterday on which the discussion was not concluded. Would Mr. Russell, who read one of the papers kindly open the discussion.

Mr. Russell : I hardly know on just what points you desire further information. You heard the paper yesterday, you have it in printed form, and I would like very much before saying anything further to hear from some of the members just what they desire to know in reference to any particular point and I will try to answer their questions to the best of my ability.

Mr. Dion : In connection with this very able paper by Mr. Russell, I would like if possible to emphasize the fact that there is a large field, it seems to me, in lighting companies for the single phase motor. We are operating alternating current and direct current motors. Until last summer we had supplied power by direct current only, and when our plant was rebuilt and we made provision for supplying alternating power we found it necessary to continue the supply of direct current to customers who were provided with direct current motors. For that purpose we have provided a rotary converter which is sufficient to carry the load of the direct current motors. We determined from that on to encourage the use of alternating current motors, our supply is two-phase, 60 cycles. Owing to the fact that the field for power in our city is not a very large one—we are not a manufacturing city in any large sense—and that the number of motors would not be very large, and because we had application for some comparatively large-sized motors and for other reasons we decided to run our power circuits entirely independent of our lighting circuits. We established a two-phase four-wire power circuit and up to this time we have operated that on a separate generator from the lighting. We have been able to do that. But we were confronted with the problem from time to time of supplying alternating power to sections of the city remote from sections where one would expect to get motors, and we either had to, at considerable expense, extend our power distributing system to these places or use single phase motors. We had not done much of that yet, but I can see this problem will be before us again and I feel that for such places we could use single phase motors to advantage. Of course, I would limit the size of the motor to be so used ; I would not care to use a very large single phase motor on a lighting circuit ; but as was said here yesterday I think it is a question as between the capacity of your circuit and the size of your motor. If the motor is run steadily all day no trouble will result. If the motor is to be started and stopped often then you have to be careful that the capacity of your circuits is such that frequent starting and stopping will not interfere with your lighting system. But I think many occasions arise where the single phase motor can be used with considerable advantage. You may have noticed from the diagrams which were exhibited yesterday that the starting torque of these motors is very large and the period of acceleration is very short, and I think it is possible to operate motors of small size on our lighting circuits without any disturbance to our lighting service. There is one point in connection with the single phase motor upon which I would like to get some more information, speaking now of the Wagner motors ; it is the short circuiting device. This device is composed of a great many parts which are attached to a centrifugal arrangement which, when the motor has obtained its normal speed, throws these parts against the inside of the commutator, short-circuiting it, and after that the motor runs as an induction motor with short-circuited rotor. It occurred to me that mechanically this might be a weak device and a source of trouble. We have not had experience enough to allow me to express an opinion one way or the other, but from those who have had experience I would like to hear whether that device is going to be a source of trouble or whether it is a reliable device. Otherwise with my limited experience I have found the single phase motor to operate very satisfactorily.

Mr. Hunt: I would like to ask what is the exact size of the single phase motors you have on now?

Mr. Dion: The largest size is 7½ h.p.

Mr. Hunt: These you put on your extreme limits?

Mr. Dion: Yes, the 7½ h.p. motor is at the extreme end of our distribution; it is about three miles from the central station.

Mr. Hunt: What voltage do you deliver?

Mr. Dion: 2200 volts; this motor is I believe about 500 volts; it is a reduction of 4 to 1.

Mr. Hunt: You have to put on a separate transformer; you don't take it off your lighting transformer?

Mr. Dion: No.

Mr. Hunt: Have you had occasion to take it off your lighting plant transformer?

Mr. Dion: No, we have not done that.

Mr. Russell: It is perfectly feasible to use a standard lighting transformer to operate these motors. The standard voltage for which we wind those is 104 or 208; you usually use either a ten or twenty to one ratio transformer for your lighting circuits and as the motor is wound for either 104 or 208 volts you can of course use that transformer. The motors are wound with that object in view.

Mr. Hunt: What range of voltage have you on it?

Mr. Russell: A 104 volt motor will operate perfectly satisfactorily on a voltage from 100 to 120 or 208 to 240 volts. Where you run a greater voltage, if the customer will only inform us, we will be glad to wind the motor accordingly.

Mr. Hunt: That will cover the case I have in mind.

Mr. Russell: Mr. Dion spoke with reference to the short circuiting device of the motor. By reference to figure 4 in the paper you will gather a good idea of the internal construction of that motor. The ones we used to make were of iron with a rubber bumper so that when they fly off and took the brushes off and short circuited the blow was not very severe. The short circuiting clips which are used to short circuit each commutator bar to one common ring are of very substantial construction. We have experienced no difficulty whatever with this device. As these clips make contact with the commutator bar before the brush leaves the commutator there is never any burning or arcing there. It was only a few days ago I had occassion to see a motor that was taken apart, 30 h. p., operating a large printing press. Those short circuiting clips had been in operation continuously for a little over five years and they were I may say in more perfect condition than when put in, for they had had a certain amount of wear which enabled them to make a better contact than they made when they left the factory. That short circuiting device is simple in its construction. To have the governing device operate according to the frequency of the circuit it is only necessary to have the spring of the proper tension. For instance, if you wish a 60 cycle motor and you have a 66 cycle circuit, if you will so inform us before that motor leaves the factory, we will put in a governing spring of the proper tension. If you should have a 60 cycle motor and wish to run it on a 66 cycle circuit it is only necessary for you to tighten that spring up to the proper tension. You may need to practice with it two or three times to get it to release at the proper speed. You do not want it to release at too low a speed or you will not be able to bring up your full load, or you do not want it to release at too great a speed or your governor might drop back when you put on a full load; but that should not happen until the speed has come down to about 1600 revolutions on a motor operating on 60 cycles. The same principles apply to a 133 cycle motor. The winding on the fields is all hand work. Great care is taken in winding so that the percentage of troubles from any cause has been less than one-tenth of one per cent. in the last four years. In Chicago they have between fifty-five hundred and six thousand horse power Wagner motors; in the city of St. Louis about 4,000; in Boston there is about 600 h.p. It is only since the first of the year they have had current that they cared to put the motors on, for they had been changing their system. They have a single phase system there now. We have about 3,000 h. p. in Philadelphia. There is hardly a station that is operating a day circuit that has not one or more of our motors on it. Frequently the small central station man thinks he is not able to get customers enough to warrant him starting a day circuit. I have given considerable time to that one feature of the business in the last seven or eight months and I have found that if a man would just get after the motor business that he was enabled to get a sufficient number of motors to give him a day load from which he derived a revenue sufficient to pay for operating the day load, probably not to make money on it at the start, but sufficient to pay his expenses, and they were in nearly every case surprised to see the amount of current they sold for other purposes; and then gradually more motors were added as people saw the advantages to be gained from using motors for operating different pieces of machinery. A great many central station managers have the impression also that they must have large generators to successfully operate single phase motors or any other alternating current motors. I have a list of a few small stations that have been quite successful in getting a good day load. At Henderson, Kentucky, they have two generators, 1-75 k.w., 1-150 k.w., and 10 motors aggregating 36½h.p.; they operate the larger machines most of the time during the day and then at night they throw on the smaller machines to help carry the increased night load. At one place in Illinois, they have one generator of 75 kilowatts and they operate a number of motors of small sizes for various purposes, totalling about 100 h. p. It would possibly be of interest to you to know something of the installation of a 25 h.p. motor there operating the pumping plant. It is 1½ miles from the central station located out in the country. They start their pumping along about 12 o'clock at night after their principle load has come down. They start the motor by simply closing the primary switch of the distributing circuit at the power station and the motor comes up to the speed, throws off its brushes, and the water starts; when the tank is about full it rings a bell in the power station and the attendant pulls the primary switch. A man goes down there once a week to see that there is plenty of oil in the oil reservoirs in the pumping apparatus and to see that there is oil in the bearings of the motor. They have never had but one break down or one shut down of that pumping plant in a little over three years during which time it has been installed, and it is operating every day, and that break-down was due to a ground on the transformers. I might mention another instance where the installation of one 10 h. p. motor is rather unique. It is located out on a farm two miles from the city. That motor is operated on a stone boat; they haul that motor out in a field adjacent to the barn and carry current to it with a cable; they operate a cross-cut saw for sawing cordwood, also corn shedders; they haul it into the barn and belt it to a small jack shaft and from that drive their corn grinder, oat clippers, deep well pump and cream separator. I went out there last winter and I found the motor up on a pile of snow ten feet high operating a corn shredder; it had a box over it to keep the snow off. I am sure if you will ever try one of the motors in your city, if you have proper materials upon which to work, you will not have any trouble in working up considerable new business. Sixty cycle motors up to and including ten h. p. operate at 1750 at full load. The synchronous speed would be 1800. Although we can give you a slow speed 60 cycle motor in all sizes operating at 1165 and 870, yet those motors are not used very extensively except where it is necessary to operate at slow speed, for direct connection or some special installation. One hundred and thirty-three cycle motors operated at 1940 r. p. m. at full load up to and including ten h. p., and 1550 r. p. m. for the larger sizes.

Mr. Read : In our plant we are using 104 to 208 and we find the 208 volt motors on the three wire system seem to work satisfactorily. The largest capacity of single phase motor we have is three h. p. ; we are using it on our lighting circuit with the short circuiting device and we had a little trouble; the short circuiting arrangement in one place ground at the core of the rotor and we had to take it apart and in that way we found its defect, but that is the only trouble we have ever had. We are using three h.p. motors in our sub-stations and on our air blast transformers. All the motors we got at first were 208, but the last motor we got from the other side was 104 and it was very satisfactory under the conditions we had, but I would advise that you should use 208. I notice with single phase motors especially, connected with the three wire system, each time you start the motor you will get a kick in the light, but it comes back alright. When the lighting load is on you will not notice it so much. As far as our experience with single phase motors goes, I think the 208 volts is the most satisfactory for our system.

Mr. Russell : We probably ship out nine out of ten of our motors wound for 208 volts. The reason is that it enables the balancing of the transformer and the lighting circuit ; and where you run off the outside of the circuit it enables you to do so with about half the copper.

Mr. Read : In the railway end of our sub-station we have a Wagner 3 h. p. single-phase induction motor, 300 volts, on the same shaft with a small rotary converter. The motor is used for starting the rotary, also to keep it from hunting and flashing, or dropping out of step with excessive overloads which the rotary is subject to in starting a 250 k. w. motor generator set. This motor can be cut out when rotary is in step with system, but we have never put a load on with motor cut out, as the rotary would hunt and eventually drop out of step. This motor has proved very satisfactory, and has operated under some very trying conditions and severe overloads. The brush releasing device gave us a little trouble at first, not being adjusted properly to suit our system, as it was a 60-cycle motor operating on a 66 cycle system, and consequently the brushes would leave the commutator too soon before the motor had reached a high enough speed to drop into step and take its load, but after tightening springs on brush releasing device, we found it worked very satisfactorily, and has given no more trouble since.

Mr. Holman : Speak of the induction motor that you have at St. Romuald, comparing it with the one and one-half single phase motor that you have somewhere else and speak of the relative troubles you had with othere.

Mr. Read : As far as our trouble is concerned, in the two-phase system we are using two-phase three-wire and we have in that section of our system about five motors altogether, two 15, a 10, a 3 and a 2 I think, and they are all two-phase. We have had trouble occasionally not only from the motors but from our transformers, and it being some distance from our station it is rather awkward for us. Our sub-station is situated at Lévis and we transmit back part of the way, and we also have a sub-station at St. Romuald which does not require an attendant. We have two Westinghouse transformers there and we have no trouble with them. We have them connected up to three-phase transmission and two-phase three wire secondary. Our two-phase motors there have been satisfactory, except as I mentioned before, we have had a slight trouble with the transformers, but with the single-phase motors we have had no trouble except that which I mentioned first, in the short circuiting device. It was one of the first motors we got ; it is the open type, I believe one of the first type the Wagner Company got out, and it came to us with the air blast transformers and has operated them about a year. We have two motors and we exchange them ; we run one motor for a few days and the other for perhaps the same length of time. We found that after a while one of the motors began to act up a little ; it began to blow fuses and the brushes would not come off, apparently some inherent defect. By examining it we found that the short circuiting ring inside the armature was grounded to the core. The other motor has been running continually since and we have had no trouble at all with it. The only trouble with our other motors, being 60 cycle motors, single-phase operating on 66 2-3 cycles, is the trouble with the brushes leaving the commutators too soon before they are really up to speed, and taking the load and dropping back and coming up again, but by tightening the springs and getting the right adjustment we have had no further trouble in that respect.

Mr. Russell : It is only a question of adjusting your governors for that purpose.

Mr. Dion : Apart from the question of frequency, assume that your short circuiting device is properly adjusted and that you overload your motor so that you get a drop of speed from the normal, how much of a percentage of reduction would be necessary to allow this device to go back and throw the brushes on again, and what will happen then, what will be the result to the motor ?

Mr. Read : We have a single phase motor on a 104 volt circuit ; it has just been put in recently ; it is operating a pump organ and there was a new governor which the organ man was trying, and he figured out it would take about one h. p. to run this organ, but this governor was not adjusted at the time satisfactorily, so we put the motor on with this governor which took almost one h.p. to bring up to speed and the motor slowed down to about twenty-five per cent. below the rated speed, but still the brushes held on and the motor was carrying almost two h. p. while it was a one h. p. motor. We did not run it any length of time when we found out what the trouble was. Since the governor has been adjusted we find that the motor is rather small and we are installing in its place a three h. p. motor, under 208 volts.

Mr. Dion : That seems extraordinary.

Mr. Read : There are very funny conditions under which this organ is pumped. They had a ninety-foot belt drive and the motor was placed in the basement ; they had three different sections of the belt and there were a number of idler pulleys, as they could not get a direct drive. This gentleman had said they had no trouble with the direct current motors because they could put them right in the organ. Under the conditions they had in there they had to place this motor down stairs and that was the reason it took so much power.

Mr. Wyley : What is the rule where a transformer is required for the motor? Does the company or the customer supply it? The company in our case.

Mr. Dion : In reply to that I would say that we have not been very long in the alternating power business. The number of motors installed is not large as yet and I don't know that our policy is clearly defined. Up to this time we have in some cases supplied the transformers on a three year contract and for less than three years we asked the customer to provide the transformers.

Mr. Higman : A dispute between a supply company and a customer in regard to the load that is being supplied has been referred to our officers. The supply company undertakes to sell 75 h.p. through an induction motor, and the consumer complains that he only gets 60 h. p. at the pulley. It is simply a question, as I understand it, as between true energy and the apparent energy. I would like to know what the custom is with central station managers as to who stands up for the wattless current ? Perhaps some one will answer that question.

Mr. Dion : I would like some one to answer that for me, too. I would be glad if Mr. Russell would answer my question, which was partly answered by Mr. Read, as to the over-loading of a single phase motor, the dropping on of the brushes, and what will happen.

Mr. Russell: If you should over-load one of our motors sufficient to bring the speed down to about 1700—with some of them the speed might drop down as low as 1400 before the brushes would go back on the commutator—if they did go back the motor would only repeat its starting again; it would try to pick up the load and carry it.

Mr. Dion: But the brushes would drop on the commutator before the short circuiting device was taken up?

Mr. Russell: Yes, sir. Suppose a customer were continually over-loading his motor—in fact you have a number of customers doing that—he would have to over-load his motor twenty-five per cent. before the speed would drop down sufficient for the brushes to bear on the commutator.

Mr. Parke: That is quite a common occurrence. Supposing it was a central station plant and you had say twenty per cent. of the customers over-loading your motors, and on account of the over-loading the speed were dropping down and the short circuiting device being thrown out and thrown in again, requiring in order to start it under that over-load a very considerable starting current, wouldn't you be likely to have a section of your system interfered with and almost impossible to control?

Mr. Russell: I would say yes, but wouldn't that be the same with any other motor, were there a tendency to continually overload the motor. Such a condition is an exceedingly good indication that something should be done to relieve the motor of its overload. The conditions you mention are of rare occurrence.

Mr. Parke: It probably would be the same with other motors, and in a case of motors without the short circuiting device I do not think you would have that cutting effect.

Mr. Russell; They would drop out of step.

Mr. Parke: In that case they would stop.

Mr. Russell: Yes.

Mr. Parke: The point I want to get at is this, there would be no device in it to cause it to cut itself out of service.

Mr. Russell: No sir.

Mr. Holman: I would suggest that this might be a good feature. When the over-load comes on you not only hear the click of that "thing," but you see the other effect of slower speed in the machine that you may be driving. You get both the ear and eye effect in having your attention drawn to the fact that something is wrong with your speed. In other words, a passing attendant belonging to the power company, if he was in the shop, would hear the click and then his attention would be called to the fact of what otherwise he would not see.

In reply to the question as to whether he had had any experience in operating passenger elevators with single phase motors, Mr. Russell said: Yes. I don't know that I can advocate the single phase motor for operating a passenger elevator, for it must be constant, and it is necessary for you to drive your passenger or freight elevator by a belt from the motor to a countershaft and use a device to stop and start and lower your elevator and you all know what kind of an arrangement that means.

Mr. Scott: I have been very much interested in this discussion. It is of great interest for those who are connected with the manufacture of motors to hear a discussion of the motors by those who are using them. There are two questions which are involved in the paper before us, one, the characteristics of the single-phase motor itself, and the other is a point which has been taken up somewhat in the discussion, the comparison of this motor with other motors from their operating standpoint. It seems to me that the parallel may not be unlike that which we had a day or so ago when we were discussing the direct current motor and comparing it with the alternating current motor and motors of different types; and as in all else, each probably has its own field which it can fill in particular cases better than the other. So here we have the single phase motor and the polyphase motor and there are certain conditions, respecting supply circuits usually, where it may be preferable to use one in one case and the other in another. Comparison was made the other day between the induction motor and the direct current motor; it was found that in general it was the consensus of opinion that it was the desirable thing to use the induction motor if possible. Now, on general principles, which of the two types of motor the alternating polyphase motor or the single phase motor is preferable? There was one statement I noticed in the papers read yesterday, namely, that the single phase motor is very simple in its operation and requires no more attention or care, if I remember the expression, than the polyphase motor. Take the polyphase motor in its simplest form and it is hard to see how anything could be simpler or if different from it could be as simple as that. Anything that has small auxiliary contacts or brushes or moving parts, although they may be made well and seldom get out of order, constitute a possibility of trouble which does not exist when these are not present. As to the point which has just been brought up, of the overloading of the motor. It is one which has its different aspects. The induction motor is a motor which stands abuse. I once, not long ago, heard this comparison made between the horse and mule: The mule is an animal that would work hard but he knew when to stop, he wouldn't overwork; you could kill him but he wouldn't kill himself. Take a horse and the horse goes into things with all his energy and don't know when to stop and with a little encouragement he would over-work himself and drop dead with his own exertions. It seems to me that the induction motor is a motor which will work right along, it is a good deal of a mule, it is not very apt to get into trouble by over-load, as it has no brushes and commutator to spark as has the direct current motor, and it has no centrifugal device to work back and forth as may occur in a critical condition with the single phase motor. But the alternating current motor is well-known to be a motor which does stand over-loading, intermittent over-loads and continuous overloads. But like the mule it will lie down when the limit is reached without making a fuss at the commutator. Motors carrying twenty-five and fifty per cent. overload for long periods are not rare by any means, and it seems to me from the station standpoint there is a common sense consideration of simplicity both in construction and operation and also in the desirable operating element that the motor when over-loaded has nothing to get out of order and is capable of carrying a very considerable overload to a very high limit. Of course, a very long continued heavy overload would burn out the motor, which would be the case with any other motor. These things give to the polyphase induction motor a claim to recognition which is not possessed by any other kind of motor—a claim upon the central station manager and upon the customer—one of simplicity and durability. I do not put that forward as an argument to prove that you should never have the direct current motor or the single phase motor, but it is one of the points which to my mind is well worthy of consideration.

Mr. Reesor read an invitation from the Hamilton Steamboat Company inviting those of the members, who desired to do so to take a trip on their boats.

Mr. Mortimer moved, seconded by Mr. Fisk, that the thanks of this Association be tendered to the Toronto newspapers for the very accurate and fair reports they have given of the proceedings of this convention. Carried.

Mr. Dion moved, duly seconded, that the thanks of this Association be tendered to the DeForest Wireless Telegraph Company, The Toronto Railway Company the Metropolitan Electric Railway Company and the Hamilton Steamboat Company for their courtesy in extending invitations to the members of the C. E. A. Carried.

At 1 o'clock p.m. the convention adjourned sine die, to meet in Hamilton in 1904.

SOCIAL FEATURES.

The Niagara Navigation Company offered members of the Association a special rate to visit Niagara Falls.

The trolley trip to Aurora and Newmarket on Friday afternoon over the Metropolitan Electric Railway, was participated in by a number of the members who greatly enjoyed President J. W. Moyes' hospitality.

The Hamilton Steamboat Company offered free transportation to members wishing to visit Hamilton, by the steamer "Macassa," and witness the receiving and sending of wireless telegrams by the De Forest Wireless Telegraph Company whilst the boat was crossing the lake. A number of the delegates took in these trips.

The excursion over the bay to the Island on Wednesday evening revealed a boat load of jolly electricians with their wives and lady friends. A special boat had been chartered—the "Chippewa"—and the famous band of the Queen's Own Rifles discoursed sweet music. At the Island a vaudeville performance was given in the open air theatre. The party returned at 11 p.m., well pleased with the Toronto local committee's generous hospitality.

The feature of the first day was the tally-ho drive to all the principal points of interest in the city. This was given by courtesy of the Canadian General Electric Company. Nine large tally-ho's with the largest electric automobile on the continent and a number of private "autos" made up a procession which attracted considerable attention. In each tally-ho was a guide who blew a long brass horn as they approached the crossings, and who also pointed out the points of interest.

By courtesy of the Canada Foundry Company, several special cars took the members and their friends out to the company's works at Toronto Junction. The trolley cars were all lavishly decorated with flags of all kinds. They were met at the works by Messrs. A. Oakley, S. M. Gray, H. G. Nicholls, J. J. Ashworth, A. C. McCallum, J. Leicester, and O. Rouleaux, officials of the company, and escorted through the vast plant. Keen interest was manifested in the making of rivets, bolts, punching of heavy plate, the working of the massive cranes, etc.

At the conclusion of the tour of the various buildings the whole party were escorted to the new store buildings, where an elaborate luncheon was served. The whole room was tastefully draped and beautifully decorated with palms and bunting. The delighted party were afterward taken back to the Kiug Edward Hotel in the special cars.

THE BANQUET.

The annual Association Dinner at the King Edward was a magnificent affair. The beautiful palms and ferns, the exotic flowers and miniature trees, the gaily decorated tables, etc., all combined to make a "tout ensemble" worthy of the King's Palace.

The dinner was held in the beautiful American dining-room. The menu card was a clever conception. The following are samples of the articles discussed at the festive board and their electrical synonyms :—"Electric juice," cocktail, 100,000 volts; "submarine insulation," little neck clams ; "direct current," chicken a la reine; "deep sea cable," fillet of black bass ; "high resistance," cucumbers; "sliding base," punch—belt driven ; "electrocuted," broiled spring chicken ; "carbon points," asparagus vinaigrette ; "tie wires," cheese, crackers; "grounds," coffee; "incandescence," cigars. Mr. B. F. Reesor, Lindsay, President of the Canadian Electrical Association presided. The toast of "The King," was loyally received, and followed by that of "Our Empire."

A splendid international feeling prevailed, and the various speakers dwelt upon the unity of the English speaking races. Col. Denison was the principal speaker of the evening. His theme was our Imperial relations.

"The Electrical Interests" brought a happy reply from Mr. A. A. Wright, M. P., Renfrew, in which he referred to the power possibilities lying loose all over our country. Mr. C. F. Scott also spoke, giving an interesting review of some phases of recent electrical progress, Mr. G. U. G. Holman, of Quebec, also spoke. The toast of "Our Guests" was responded to by Ald. Ward and Dr. J. O. Orr.

Letters of regret were read from Hon. Geo.W.Ross, Hon. J.M.Gibson, Mr. J.P.Whitney, Mayor Urquhart, Mr. Frederic Nicholls, Mr. H. P. Dwight, Hon. Rich'd Harcourt, Col. Pellatt, Mr.W.H. Browne, Mr.Stephen Noxon (Ingersoll), Mr. E. H. Keating, Mr.K.B.Thornton, Montreal, and Prof. Galbraith, Toronto.

Speech-making was only a part of the programme. The musical entertainment included excellent orchestral numbers, solos and recitations by Mr. Arthur Blight, Mr. J. B. Coulthard and Mr. W. A. Martin, and witty speeches by many present.

A very thoughtful act on the part of Mr. A. B. Smith, of the G. N. W. Telegraph Company was in having the room where Mr. J. J. Wright was lying ill, connected by telephone so that the latter heard all tha passed in the banquet hall.

THE TRAINING OF THE HIGH TENSION ENGINEER.

BY P. M. LINCOLN.

Why, you ask, have I chosen to discuss this matter of the training of the engineer instead of some phase of practice or theory of high tension. Why talk about education instead of the maximum voltage that can be used in an electrical transmission or the proper spacing of high tension conductors, or the maximum distance to which power can be profitably transmitted? My answer is, because I consider the human element of this transmission problem of more importance than the material element. An electric transmission is a creation of ideas, of engineering ability and skill rather than one of mere poles and cross arms and copper. The indispensable part of the transmission is the man of ingenuity and enterprise and energy. Get the right kind of a man and long distance transmission is practicable ; without him, all kinds of trouble are likely to develop.

There are two schools in which the electrical engineer may receive his training, but only one in which he must receive a course before he can be called a high tension engineer. Those things which are learned in the schools equipped with professors and laboratories and mathematical text books must be supplemented by the things which can be learned only in the school of experience. These two schools are quite different in method. The college instructs in theory and in those methods of doing things which have become standard by universal adoption. The college teaches positive knowledge. In the school of experience, on the other hand, one is more apt to learn how not to do it, and by the elimination of the unsuccessful, arrive at the goal of success. The knowledge gained by experience is more often negative.

Who is it that answers the innumerable queries that arise when a transmission scheme is in question? It is the engineer. The engineer decides what voltage shall be used, what frequency shall be adopted, what loss is the most economical, the proper cross section of copper to be used, the distance apart of the conductors, the kind of insulators, the spacing of poles, the height of conductors above ground, and the thousand and one other questions that arise. It is on the engineer's knowledge and skill that the success of the transmission depends.

It is to the man—the engineer—then that we look for advice on matters pertaining to high tension transmission. How is the engineer to gain the necessary wisdom to give such advice? In two ways :

First—By mastering the laws which underlie the science of electricity—the training as given by the college education.

Second—By coming into contact with the problem personally—the training as given by experience.

Both theory and practice are needed to make the complete engineer. He may pick up theory while engaged in practical work, but he can never pick up practice while engaged in theoretical work.

Put to the fresh college graduate the problem of the amount of distance to be left between the conductors of a high tension transmission line. His answer will involve most likely the jumping distance of the voltage to be used, the length of span, the sag, and perhaps a liberal factor of safety. It is experience only that will show that his premises are wrong and that the equation to determine spacing of high tension wires depends very little on the voltage to be carried and almost entirely on such things as the [illegible] length and [illegible] of the spread of wing of owls and cranes and eagles, and the average length of scrap baling wire, together with the strength of the average small boy's throwing arm.

The average graduate enters practical work invariably feeling that the greatest danger of his work lies in his liability of receiving a shock from the high tension conductors. Not until he has had experience with accidents of an electrical nature does he learn that it is the danger of being burned that he has to fear more than the danger of shock. My own experience, and I think it will be checked by the large majority of those in a position to know, has been that the number of electrical accidents in which the victim has been injured by burning is incomparably greater than the number from shock.

The graduate has learned how to make accurate measurements of power. He finds after he has been "up against it" that it is easier to measure power accurately than it is to persuade the customer that his power is being accurately measured.

The man fresh from the college laboratory enters his practical duties with the idea that rubber is one of the best insulators that exists. It is not until he has seen rubber insulation break down in the most unaccountable manner that he finds that rubber as a high tension insulator is extremely treacherous. The deterioration of rubber insulation is probably due to chemical reactions on the rubber induced by the brush discharges, which are in turn caused by the high voltage of the conductor.

The newly made graduate usually has a high opinion of efficiency and can calculate the economy of a transmission to an excessively small fraction. When he becomes responsible for the operation of a transmission line, however, it does not take him long to find out that efficiency is a vanishing quantity when compared to continuity of operation, and that economy is not to be considered as being in the same class as good service.

The technical graduate, in short, may have knowledge a-plenty, but his wisdom is to come.

It is furthest from my thoughts to cast any slur upon the technical graduate. I look back upon my own course in electrical engineering and feel that it is the most valuable asset I ever possessed. The technical course is the best of foundations, but it is only a foundation. The end of the college course is rightly called "Commencement." The great advantage of the technical education is that it gives the man proper equipment for overcoming the difficulties with which his experience is bound to bring him into contact. It gives him, as nothing else will, the power of initiative—that most valuable quality that a high tension engineer can possess. There is nothing like the college education to equip a man for making every accident a lesson in "how not to do it," and every failure a stepping stone to success.

Take, for instance, the recent accident to the Niagara plant, in which a fire destroyed the cables on the bridge connecting the power house with the transformer house. The lesson to be drawn from this accident—so plain that he who runs may read—is that where many cables are run together extreme precaution should be taken to protect against danger of fire. Before the occurrence of this fire there was little suspicion that the insulation of cables when lead covered or protected by fire proof braid — as was the case at Niagara—is sufficient to maintain so fierce a blaze without the aid of some other combustible beside the insulation. One accident of this kind should suffice, not only for the Niagara Falls people, but also for any others who have occasion to run many cables together.

The need of high tension engineering is for men; men with education; men with brains; men with experience. Where shall we get these men? How shall the supply keep pace with the demand? The members of the Canadian Electrical Association and of kindred societies are best qualified to answer this. You are the men who are now operating and designing transmissions. If you treat your knowledge of these things as if it were a plague, cork it into a bottle and label it "poison," the art of long distance electric transmission must surely suffer therefrom. You are the teachers, the professors in the school of experience. It is to your pupils that the next generation must look for its engineers.

You will pardon me for referring here to the work that the American Institute of Electrical Engineers is carrying on through their Transmission Committee. They were appointed for the purpose of "collecting data respecting present practice in electric transmission at high voltage." They are now engaged in that work. Whether their labors are successful or not depends not so much on them as on you. Without the co-operation of engineers in general their work of collecting data and of presenting a report thereon cannot succeed.

One of the methods which this Committee has been using to obtain data and get it for the Institute is to prepare and present to the Institute a series of brief Introductions to Discussion. The object of these Introductions is not to treat the subject on which they are written completely, but rather to simply put the matter before the Institute in such shape that the points raised can be discussed by those who are in position to give opinions of value. A mere statement of the subjects which have been written about, and a brief résumé of the matter in which the subject was treated, may be of interest in this connection.

On March 27th there were presented to the Institute the following four Introductions to Discussions:

"Mechanical Specifications for a Proposed Standard Insulator Pin," by R. D. Mershon. This, as the title will indicate, was a discussion which proposed standard dimensions for all future insulator pins for high tension lines. The reasons for wishing to adopt a standard insulator pin are apparent.

"The Testing of Insulators," by F. O. Blackwell. This is a paper which describes the methods which experience has shown to be the best in testing high tension insulators.

"Transposition and Relative Location of Power and Telephone Wires," by P. M. Lincoln. This paper gives a discussion of the influence on telephone wires by the action of high tension wires on the same poles, as well as proposing some methods for overcoming the difficulties thus caused.

"Burning of Wooden Pins on High Tension Transmission Lines," by C. C. Chesney. This is a discussion which treats of the disintegration of pins on high tension lines. This disintegration does not always occur, but it has been frequent enough to raise a considerable question. This paper shows a number of photographs of pins so burned, and briefly discusses a remedy.

At the Annual Convention an entire day is to be devoted to the discussion of high tension subjects. A number of Introductions to Discussion have been written for presentation on that day; they are as follows:

"On the Testing of Electrical Apparatus for Dielectric Strength," by P. H. Thomas. This is a paper which briefly discusses the testing of electrical apparatus, both before installation and after installation. It points out the risk which is apt to be taken in giving apparatus high potential tests after its installation.

"Methods of Bringing High Tension Conductors into Buildings," by C. E. Skinner. This is a discussion of the various methods which have been used in the past for bringing high tension wires into sub-stations and main stations; it also gives sketches showing a proposed way of accomplishing this object.

"Y or delta Connection of Transformers," by F. O. Blackwell. This discussion treats of the relative methods of Y and delta systems of connecting transformers for high tension transmission. The subject is one of considerable importance and deserves careful study.

"Choice of Frequency for Very Long Lines," by P. M. Lincoln. This is an analysis of the various items which enter into the choice of frequency for long transmission lines. The drift of this discussion is that as the distance of transmission increases it becomes advisable to decrease the frequency.

"The Grounded Wire as a Protection Against Lightning," by R. D. Mershon. This is a discussion of the theory of lightning protection by a parallel grounded circuit. A number of new points are brought out and the value of such protection from a theoretical standpoint as well as some practical experience along the same lines are pointed out.

"The Operation and Maintenance of High Tension Underground Systems," by Philip Torchio. This discusses the various points that enter into the operation and maintenance of a large underground system of high tension conductors, giving methods of testing and a considerable amount of valuable data in connection with cables.

"Electric Cables for High Voltage Service," by H. W. Fisher. This paper gives a number of valuable points in connection with the manufacture, installation and operation of high tension cables.

"The Use of Automatic Means for Disconnecting Disabled Apparatus," by H. G. Stott. This is a discussion on the value of automatic apparatus for disconnecting any part of the system, including generating apparatus, transmission apparatus, and receiving apparatus.

The value of reversed current breakers is taken up and discussed, as well as the application of simple overload devices.

You will note that all of the subjects above mentioned are of vital interest, and information concerning them will be eagerly sought by all persons interested in the transmission of electrical energy. It is the intention and mission of this High Tension Transmission Committee to bring before the American Institute of Electrical Engineers as much data on these subjects, and kindred subjects, as possible.

The art of long distance electric transmission as it exists to-day is the result of the accumulated experience of all those who have had to do with transmission work. And the process of accumulation is still going on. Those men who are to-day designing and operating transmission plants are the moulders of the art. Their expedients for improving service or reliability or for cheapening cost are noted, and when successful have their influence on future installations.

The experiences of to-day are incorporated into the text books of to-morrow. But, although the result of experience may be taught to the college student—allowing always for a considerable angle of lay—the college curriculum can never become the substitute for the school of experience.

VARIABLE SPEED MOTORS AND THEIR RELATION TO NEW SHOP METHODS.

By R. T. Lozier.

Progress does not always follow a single road; many times we find it advancing along converging byways which come together in the main highway along which it then rapidly goes towards its destination, which is the ultimate ideal.

Many times those travelling the byway know little of the companions which they are to join at the cross roads, and so it was that where George Bullock ten years ago in his first shop decided to put individual motors on his tools because it appealed to him as being good engineering, he little knew that on a parallel road Ward Leonard was progressing with his Multi-Voltage System for controlling such motors, while on still another road the engineers at Bethelem, Pa., and elsewhere were determining how to run a shop from the standpoint of true engineering rather than by the rule of thumb.

The speed of the individual motor could not have been fully controlled successfully if it were not for the Multi-Voltage System which would never have had its application if it were not for the development of the individual motor, and the new shop methods could never have reached their present development if it were not for the individual motor properly controlled. In fact, the shop methods would never have gone beyond the highly developed theory of the academician. I am not losing sight of the possibility of using a mechanical means of varying the tool speed while it works, but these devices have not been developed as yet.

What these three factors now joined together are able to accomplish is this: Working every machine tool in a shop at its highest output, thereby making it possible to increase the output of the average shop operating under the old conditions by 300 to 400 per cent.

This is the one great feature which is the resultant of these combined improvements which subordinates all others although of the latter there are many.

Let us consider for a moment each of these methods from its own standpoint and in its natural order.

NEW SHOP METHODS.

In days gone by, if a certain piece of work was to be done, a drawing showing the essential dimensions accompanied the stock which went to the machinist, who followed his own way in

a—Setting the work.
b—Selecting the cutting tool and grinding it as he best knew.
c—Choosing the running speed.
d—Determining the cut.
e—And adjusting the feed.

The completion of the work was

1—Limited by his intelligence.
2—Restricted by his experience.
3—Governed by his inclination.
4—And was subject to the limiting conditions laid down by that despot, "the walking delegate."

Result: Four hours taken to do what could be accomplished in less than one, and with a greater degree of accuracy in the latter case.

The first step towards improvement was to take the method of doing the work out of the hands of the operator and place it in the hands of an expert. This expert issued what has been termed a "method card," on which the machinist is told how to perform all the operations involved; setting the work, the kind of tool and its cutting edge, the cut and feed, and last, but not of least importance, the speed. It was at once found that the all prevailing method of driving from pulleys of fixed speed on to cones of limited range and few steps, was entirely too inflexible and greatly restricted the desired results; one step on the cones would be too slow and the next too fast. The exact speed could only be obtained by chance. Furthermore, it was found that the higher cutting speeds that were possible could not be obtained without changing the driving pulleys.

In the desire to work the cutting tool to its highest rate of displacing metal, exhaustive experiments were made in the quality and temper of the steel during which the so-called air-hardened steel was discovered. With this new steel it was found that a cutting speed of 100 feet a minute was ordinary, where 20 feet a minute with the old tool steel was the limit. Five times faster could the tools be run than formerly. But we find the highest speed obtained by the old arrangement of belts and cones five times below that required to work the new cutting tool up to its requirements. Change the pully ratios and speed up the cones and two conditions at once develop; first, the cones have not steps enough, before they were applied through a ratio of 7 to 1; now through a ratio of 35 to 1, and while the four changes were almost inadequate for the 7 to 1, now they are five times so. But that is not the only trouble; the belt will not pull the load, because the high rate of cutting the metal requires a proportionate increase in the power.

It is now readily seen that if we are to benefit by the new cutting steel and improved methods, we must have a means of driving the tool that will give it as much range of speed as is desired and as much power as the cutting tool demands to perform its work. We are all aware that subdivision of power by electric transmission is a good thing, but the element of broad speed variation brings it down to the individual application of the motor to the tool.

And now we are down to the meat of the nut we are cracking. What kind of a motor do we want and how much, and how are we going to vary its speed.

In most cases a standard shunt wound direct current motor of about 600 revolutions at 250 volts is the thing for all classes of work. Its principal features should be:

a—Its armature coils of a type designed to carry heavy overloads without deterioration of insulation.
b—Its design to provide for low armature reaction to permit of high speeds with weak fields without sparking.
c—Its structure to be of the protected type (but the enclosed motor is to be avoided except for special cases).
d—It should be on a condensed and handy form, so as to be conveniently applied to any class of tool.
e—It should be interchangeable so that it can be applied to any tool without being specially designed for that purpose.

In this manner a stock of motors can be drawn upon for such necessities as may arise and of such capacity as the particular tool in question may demand, one motor being readily exchanged for another should circumstances require.

It must be particularly borne in mind that this motor is no ordinary machine that drives a load, the maximum limitations of which are fixed by a belt that provides a means of slipping. The tool motor must be all "guts."

Now as to the range of speed that it must operate through. This is really the backbone of the whole system and involves a careful consideration of every process of the work performed in the shop to be driven. It might be said, in determining the speed range for a shop, that the minimum speed of any one tool is determined by the hardest material it is to cut and having the largest surface to be machined, while the highest speed is determined by the softest or easiest material that is to be machined on the tool and having the smallest dimension to be machined. For example, if we have a lathe working high carbon steel, the surface to be machined having a diameter which is the limit of the tool's head stock, and we cut at a rate of 10 feet a minute, we may assume this to be the slowest speed that the tool's spindle will be called upon to run at. Now, if on the same lathe we expect to machine a piece of soft iron having a diameter to be machined 1-10 of the capacity of the lathe (that of the head stock diameter) we then have a circumference 1-10 of that in the first case, and the spindle must run ten times as fast to keep up the same cutting speed, but we can machine soft iron ten times faster than hard steel, i.e., 100 feet a minute, consequently our spindle speed must be 10 x 10 or 100 times faster than in the first case. This gives us a speed range of 100 to 1, which determines the limits of the speed for this particular tool if it is to be used for the purposes above described.

In determining the speed ratio to be used in a shop, it should be selected with a view to meeting the maximum requirements of any operation in this shop. Of course, there may be one or two special processes which may have a special speed arrangement for their particular cases, but it will be found that in the average shop the speed requirements vary within certain fixed limits that will apply to the majority of cases.

Having determined what our speed range is to be, the next step is to select the methods for obtaining same. Of these there are three, viz.:

1—Mechanical.
2—Electrical.
3—A combination of the Electrical and Mechanical.

Let us consider these in the order in which they come

MECHANICAL.

Under this heading we have two sub-divisions—

a—Those devices that permit of a change in speed only when a tool is not doing work.
b—Those devices that permit of a change in speed when a tool is doing work.

Of the former there are the well known and commonly used back gears, and I believe we can truly include the common cone pulleys, the belts of which are changed while the spindle of the tool is in motion, but hardly while the tool is doing work.

Of the latter, there is to be found a great variety such as the Evans' Friction Cone, Reeves' Pulley, Combination of gears and friction clutches which will release and clutch from one combination to another, sun and planet gears, etc., etc., but as yet no one of these methods has been able to fulfil all of the conditions of transmitting relatively large horse-powers at high speeds as demanded by the new shop methods. Each of these devices has perhaps its own application, but in a limited way only.

ELECTRICAL.

In the electrical system we vary the electrical conditions in the motor itself so that the speed may be changed within a given range with perfect ease, whether work is being done by the motor or not.

The relative advantages and disadvantages of these two systems may be stated as follows:

Any of the mechanical methods has the advantage that in reducing the speed of the tool, the size of the motor may remain the same if the same amount of work is to be done by the cutting tool. This does not hold true if the motor speed is varied within itself electrically.

The electrical method has the advantage that it can vary the speed of the motor as it runs, at will, and while the work is being done this has an advantage that the mechanical method does not as yet possess to anything like the same degree.

It therefore appears best to combine the advantages of the mechanical and electrical methods of control wherever the requirements of the case demand a large range of speed.

The practice now is to use a mechanical arrangement in connection with a variable speed motor, the former consisting of a single or double reduction back gear which enables the motor to reach the lower speeds of the range which are thrown out, and the motor run directly on the spindle in the higher speed range. It will be noticed, of course, that when driving through the gears the motor speed is varied in the same manner as when running direct.

Now, having determined the range of speed and the methods to be employed in covering same, the next thing is to determine exactly what part of the range the motor will cover by its own speed variation, and to what extent it must depend upon gears.

In my paper before the American Institute of Electrical Engineers of December, 1902, volume 19, No. 10, subject "The Operation of Machine Shops by Individual Electric Motors," I give graphic illustrations of the two methods of varying the speed of motors in such a way that the motor can operate constantly at any one speed of its range independent of whether the load varies or not while on that speed. Of these two methods one is the Multi-Voltage System, which reduces the speed of the motor, and the other is the field control, which increases the speed of the motor by weakening the field, and these two methods determine the range of speed that a motor can successfully cover. I might state that the Multi-Voltage System covers the amount of current that must be handled at the lowest voltage, while the field weakening determines the high limit when it reaches the sparking point of the motor, or perhaps the armatures peripheral speed. In common practice the speed ratio in the motor itself of 7 1-2 to 1 is found to fit the majority of cases. In this arrangement the lowest voltage is 90, and the highest 250, the field of the motor being weakened so as to increase its speed by 150 per cent. There are, however, several combinations to select from, and it is only necessary to determine just what rating a motor should have to get the desired speed range for a given horse-power to be exerted throughout that range.

Mr. William Cooper, in his paper before the Cincinnati Chapter of the American Institute of Electrical Engineers, subject "Methods of Speed Control," volume 20, No. 4, presents a method for determining the exact horse-power and speed rating of a motor in which can be combined to the best advantage field control and Multi-Voltage control in order to cover a given speed range with a given minimum horse-power.

I would refer you to Mr. Cooper's paper, which can be obtained by application to the Secretary of the Cincinnati Chapter of the American Institute of Electrical Engineers, Norwood, Ohio, for a full description as to the use of his methods. In presenting his paper, Mr. Cooper has stated the following interesting deductions:

1—The total range of speed using both variable voltage and field regulation will be as the square of the range of voltages.

2—Change of horse-power will be directly proportional to change of voltage on armature, field being constant.

3—Change of horse-power by change of field strength will be inversely proportional to change in speed, voltage on armature remaining constant.

4—The relative size of motor as referred to the maximum speed will be directly proportional to its speed variation when using variable voltages.

5—The relative size of motor as referred to maximum speed will be as the square of the speed variation when using field regulation.

Having the method to determine the exact range of speed that the motor is to cover in itself, it then simply remains to attribute the balance of the range to the mechanical device, and this may be accomplished by using one or two gears as may be necessary. The controller should have as many steps as will provide a speed curve having a geometrical development.

We have departed somewhat from our text in following the progress which enabled us to successfully apply the electric motor to the new shop methods, but, perhaps, I have been able to show that the same exact engineering has been applied in giving the maximum result for the minimum expenditure in the development of this feature of the new shop methods as has been applied in determining the operating and mechanical features of this new shop method, and all of which contribute to get the maximum result for the minimum expenditure from—

1—Fixed charges or general expense such as interest on investment, superintendence, etc.

2—Workmen's time.

3—Power required to operate plant.

The individual motor contributes the following collateral advantages quite independent of the other features of the new shop methods :

Clear overhead space, permitting the use of cranes, and giving improved light and ventilation.

Condensed shop space, because the tools can be set much closer when individually driven, than if operated by belts with counter-shafting.

Ease with which shop lay out can be arranged or rearranged, because the tools do not depend upon fixed lines of shafting, and can be readily moved from place to place.

A much lighter shop structure, because the side walls and ceilings do not have to support heavy line shafting.

I have not attempted to introduce engineering data to bear upon the matter herein discussed. It would take too long, and I would refer those who are particularly interested to the considerable matter that has already been presented to the American Institute of Electrical Engineers and Engineering Journals, etc., but suffice it to say that the individually-applied motor goes a long way towards enabling the new shop methods to place in the hands of the employer a means of discounting the demand of the labor union for shorter time and higher wages, which means consists of working his men and his tools at a far higher rate of efficiency, the ultimate result of which is a much greater output, despite the increase in pay roll and the shortening of the hours worked.

SOME POINTS RELATING TO SUBMARINE ELECTRIC POWER CABLES.

By G. U. G. Holman.

The sub-marine power cable belonging to the Canadian Electric Light Co., which supplies one thousand horse power to the Quebec Railway, Light & Power Co., in the City of Quebec, is laid on the bed of the St. Lawrence River, the terminal cable bells being approximately 3,400 feet apart.

A description of the laying of this cable was in the June, 1902, Convention Issue of the Canadian Electrical News, but as some of the audience may not have noticed in particular this article, I will say that we laid this cable amid floating ice conditions on December 18th, 1901.

The interruptions of service have taught a few lessons to us, as well as to the Cable Manufacturing Co., and it is these which I intend to mention in this paper.

This cable, which we will call No. 1, since we are now laying a second cable in the St. Lawrence River, is composed of four nineteen strand conductors, each of an equivalent of 2-0 solid copper. Each conductor is covered with a 40 per cent. Para rubber compound to the thickness of 4-32 of an inch, and then wrapped with one layer of 3-inch black, insulated, tape. The four conductors are twisted one revolution in four feet, about a common jute centre with four No. 14 B. & S. gauge, solid copper, rubber-covered wires, as pressure wires, laid-in between the four heavy conductors on the periphery of the cable. The whole was then covered with heavy rubber filled tape and served with two layers of tarred jute. An armor of thirty No. 6 B. W. G. galvanized steel wires was spirally laid over the cable.

The weak point was early shown to be the pressure wires.

One of the pressure wires open-circuited in June, 1902, six months after the cable was put in service. In August, 1902, a second one open-circuited, and in October of the same year a breakdown in the cable occurred which showed itself on one of the pairs of conductors—the cable being used for two phase transmission.

Upon minute examination of the break, which was much more difficult than would appear in the writing of this account, it was evident that a ground between the armor and one of the power conductors so weakened the insulation by virtue of the heating at that point of the rubber insulation, that a short circuit ensued between the two neighboring conductors.

Further, it is the opinion of Mr. Henry and Mr. Reed, the general superintendent and the construction superintendent respectively of the Canadian Electric Light Co., as well as my own judgment, that the insulation between the armor on one conductor was weakened by the continuous inductive spark at the point in one of the pressure wires where it had open-circuited. From a careful weighing of all the facts it is evident that—overlooking the only have developed through the apparently insignificant fact of the minute sparking at such open-circuited point in the pressure wire.

The repairing of the cable at this point was effected, and the cable has been in successful operation since that time, except from a defect caused from what we term a mechanical cause, or a cause from the exterior of the cable and by ice, in contrary distinction to an internal electrical cause.

Although the engineer of the Cable Manufacturing Co. and the writer carefully discussed the question before the cable manufacture of the insertion of pressure wires in this cable, it was not deemed bad engineering at that time to place such wires in the cable under discussion. This engineer has had as much submarine cable experience as anyone in America, but he has learned something through the faults in our No. 1 cable, so that in placing the order last fall for a No. 2 cable, four flexible power conductors alone are in this No. 2 cable. We even discussed, at the time of placing the order for the No. 1 cable the question of placing the pressure wires in the centre of the cable rather than towards the periphery, but it was not at that time deemed unwise to place them in the peripheral position, but our experience shows that what we thought to be very unlikely actually did occur; that is, that it is a mistake in cable design to place the pressure wires on the outside of the larger conductors where such small wires would be subjected to greater mechanical movement than in the centre of the cable, and that even if they had been placed in the latter position, there is too much danger of their causing trouble to the insulation of the larger conductors.

Of course it can be theorized that had we made the No. 14 solid pressure wire of strands of wires we would not have had the breakdown, owing to the break that we did have, possibly occurring at the point where the solid wire was jointed by an electrical weld.

The greatest danger in future with our cables in the St. Lawrence River, and in fact any rivers of this northern climate, is from the ice conditions in the spring of the year. It is, consequently, absolutely essential to not only protect the shore ends from the action of the ice grinding against the cable itself near what would be the surface of the river, but to protect the cable as it lays on the river bottom where the cable approaches the shore ends. This has been shown by some experience that we have had and that experience has taught us that in laying up the cable to the shore end where is, as may be expected, the greatest movement of ice down river, we should approach the shore within several hundred feet at a point about the same distance down stream and thence make a detour of the cable towards the terminal point. The river depth at such a distance from the shore is invariably greater than nearer the shore. As the ice catches on the bottom of the river and rotates huge cakes no damage is likely to ensue if the line of the cable be in the general direction of the movement of the ice. The overturning cakes of ice will not tend to catch in the cable as they would if the cable be laid at right angles to the direction of the flow of the river, and, where it does cross at right angles, it would lay at a point considerably below the surface of the river where the ice will not touch the cable.

The cable bells, or ends, which we have used have proven very satisfactory and are merely brass tubes five inches in diameter with 1-8 inch walls brought down to a conical shape with a small hole of the size of the exterior of the cable, the tube being two feet long and flanged, or belled for an inch. So that with this cable end slipped over the cable and the insulation compound melted and poured in the bell is completely filled between its walls and the four conductors separated as far as possible at equal distances from each other and about one inch from the mouth of the bell, the insulation compound, ozokorite, being brought to the top.

I will say that in our method of laying this cable on the two occasions that we have done so, we have had the use of a special large reel capable of holding it entirely. The reel is on trunnions geared about 10 to 1 to cranks on each side of the reel, which are moved by man power.

Our experience shows us that it is essential to lay the cable slowly in order to be sure and follow every indentation in the river bed, as, in the drop of 170 feet, which is the depth at some points of the St. Lawrence River where our cable is situated, more time is necessary for the cable to be laid on the bottom of the river than what, at first thought, might be considered possible.

Briefly, our experience is to never put conductors of materially different sizes within the same armored cable, and also to be very careful, in our climate, of the shore ends.

The No. 2 cable, which we are about to lay, has nearly twice as heavy armor as the No. 1, as it will have No. 4 B. W. G. instead of No. 6 B. W. G. galvanized steel wire spirally served on the cable, as in the river between Quebec and Levis there are four other cables of the telegraph and telephone companies, and as the gentleman who assists us in our cable laying operations has charge of similar work for the telephone and telegraph companies, we are able to say that the problem of laying a 100 pair telephone cable is a different proposition from laying a two-pair cable of an electric power company, weighing seven pounds per foot.

For protection against static discharges, and lightning entering the cable to ground, we are using G. E. lightning arresters on each conductor, and with success.

One effect of cable transmission is very noticeable and that is the smoothing out of the voltage variations. The output end of the cable presents a smoother record curve than the in-put end. The cable is a condenser into which energy is pushed and the surplus energy overflows.

We also find a curious inductive effect, producing 1,300 volts on opposite leads of the two phases, although there is a difference in voltage between phases of 2,200 volts.

In cable repairs we use pure Para rubber tape several inches wide and about 1-32nd of an inch thick. Also a mucilage made of pure rubber clippings dissolved in gasolene. The mechanical joints in the stranded conductors are made in the usual manner, but removed six or eight inches from each other along the cable length. The pure rubber tape is then laid on and the foregoing described mucilage pasted between the rubber tape layers. The insulation joint is so perfect that cutting it discloses a solid rubber covering.

The joints are then laid in together as are the cable conductors and wound with tarred jute. The armoring of a cable joint is the most difficult job mechanically, but the steel wires are intermingled for several feet and then tightly brought upon the cable by wrappings of smaller galvanized steel wires.

I know that there are some power cable installations in contemplation and if this paper suggests anything to the minds of those considering the subject, or, if I am able to answer any questions presented by members or friends of the Canadian Electrical Association, I shall feel more than repaid for my slight effort in presenting this paper in which Mr. Henry and Mr. Read of the Canadian Electric Light Company have had a hand.

SINGLE PHASE MOTORS AS A MEANS OF INCREASING STATION EARNINGS.

By W. A Layman.

An electrical central station with its auxiliary distribution system, is a manufacturing plant, and the same general principles of operation apply to it as to any other form of factory. There must be the greatest possible simplification of output; production must be maintained on as nearly uniform basis as possible; and the full productive capacity must be sold, if possible. Economical operation of central stations is therefore inevitably drifting toward the ideal basis of generation of one form of current, and the development by every means possible, of a high load factor. Further than this, operating engineers are specifying the installation of consuming devices, which afford the lowest first cost, and the simplest possible system of distribution. The single phase alternating current motor lends itself readily to the development of this general scheme of economic production in ways it is the purpose of this paper to briefly set forth. The following concise statement of facts will be accepted—the writer believes—by all central station men who are familiar with the performance of the single phase alternating current motors, as built by the Wagner Electric Mfg. Co.

1st. The single phase motor has reached a high stage of mechanical and electrical development, and is to-day thoroughly reliable for all kinds of power service, not involving frequent starting and stopping, and speed variation.

2nd. The average single phase motor is equal in its electrical characteristics to the average polyphase motor.

3rd. The single phase motor calls for no larger degree of inspection and maintenance expense than the polyphase.

4th. The operating engineer of a large alternating current station would prefer an equipment of polyphase generators, with single phase distribution system, for service of all kinds, if possible. Difference of opinion exists between operating engineers of polyphase plants as to the extent to which single phase distribution may be judiciously employed, based upon the results obtainable with single phase motors.

5th. The operating engineer of a small station would prefer single phase generators, and single phase distribution exclusively.

The writer of this paper is an advocate of the following arrangement of station service:

(a) For large plants. Polyphase generators, with switchboard arranged for operating:

1st. Polyphase feeders for all large power and rotary converter service.

2nd. Single phase feeders for all general lighting service, and for all small power work, the switchboard facilities being such that any single phase feeder may be switched to either phase of the generator busses.

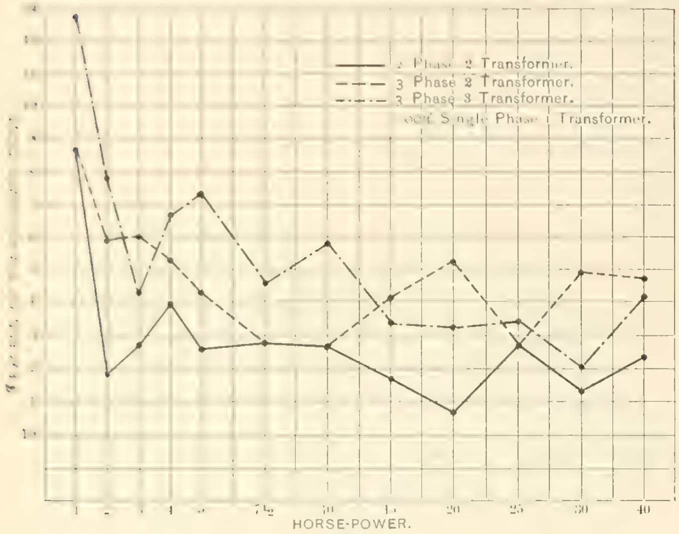


Fig. 1.

Curves showing excess of first cost of transformers for multiphase motors as compared with single phase.

(These curves are based on price list of one of the large companies.)

3rd. Independent feeder regulators for all polyphase as well as single phase feeders.

(b) For small stations. Either polyphase generators with single phase feeders, which may be thrown by the proper switchboard devices to either phase of the generator, and each feeder provided with independent pressure regulator; or single phase generators, with single phase feeders, each feeder being operated with independent pressure regulator.

This policy with respect to station and distribution equipment is advocated on the conviction that the single phase motor has come to stay, and that it affords an alternating current central station—polyphase or single phase—the ideal means of distributing small power. There may be a difference of opinion between the writer and central station engineers as to the scope of the term "small power," but in the writer's belief it is a generally conceded fact that the single phase motor is the central station man's best instrument to economical power service up to units of a certain magnitude. The writer believes single phase motors should receive preference of the operating engineer of multiphase stations, up to units of at least 15 H.P. capacity, and, in selected instances, up to units of even 35 H.P. capacity. The limit of size is fixed naturally by the unbalancing effect produced between phases of the polyphase system. Polyphase stations of the writer's knowledge are successfully operating single phase motors of 35 H.P. Single phase stations with individual generators not exceeding 75 K. W. capacity, are also successfully operating with single phase motors of 30 H.P. each.

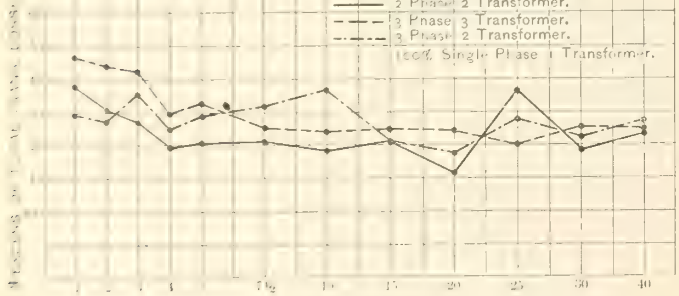


Fig. 2.

Curves showing excess of transformer losses for multiphase motors as compared with single phase.

The justification for the use of single phase motors by polyphase plants arises from the lower first cost of individual power installations, and also the higher efficiency in small units of these installations. As illustrating the high first cost in step-down transformers alone, for polyphase motors, as compared with single phase motors, your attention is called to Fig. 1, and as illustrating the high core losses of step-down transformers for polyphase motors, as compared with single phase motors, your attention is called to Fig. 2.

The curves in these two figures are plotted on the basis of standard sizes of step-down transformers now prevailing, and the sizes of transformers required under the various conditions of service are those shown in the following table:

TRANSFORMERS REQUIRED

H P of Motor	Single Phase	2-Phase 2-Trans.	3-Phase 2-Trans.	3-Phase 3-Trans.
1	1-1 K W	2- .6KW	2- .6KW	3- .6KW
2	1-2 "	2-1. "	2-1.5 "	3-1 "
3	1-3 "	2-1.5 "	2-2 "	3-1 "
4	1-4 "	2-2 "	2-2.5 "	3-1.5 "
5	1-5 "	2-2.5 "	2-3 "	3-2 "
7½	1-7.5 "	2-4 "	2-4 "	3-2.5 "
10	1-10 "	2-5 "	2-5 "	3-4 "
15	1-15 "	2-7.5 "	2-10 "	3-5 "
20	1-20 "	2-10 "	2-15 "	3-7.5 "
25	1-25 "	2-15 "	2-15 "	3-10 "
30	1-30 "	2-15 "	2-20 "	3-10 "
40	1-40 "	2-20 "	2-25 "	3-15 "

When the increased cost of polyphase line construction is taken into consideration, there becomes quite evident a material advantage for the single phase motor, even though the first cause of the motor, as compared with a polyphase motor of the same size, may be somewhat in excess of the polyphase motor. There is a rapidly developing tendency toward the installation of single phase motors, on polyphase stations, and as the possibilities of the single phase motor as to-day built are becoming better understood, it is the writer's opinion the use of single phase motors will grow with even greater rapidity. An instance recently occurred in which the contracting department of a large company agreed to supply polyphase current for 50 1-2 H.P. polyphase motors to be located in retail stores at isolated points on the distribution system. Each motor required an equipment of two step-down transformers. Upon installing the first motor it was found the idle transformer losses exceeded the effective load on the motor, and it is needless to say the operating department declined to carry out the contract made by the contracting department, and insisted upon the substitution of single phase for the polyphase motors.

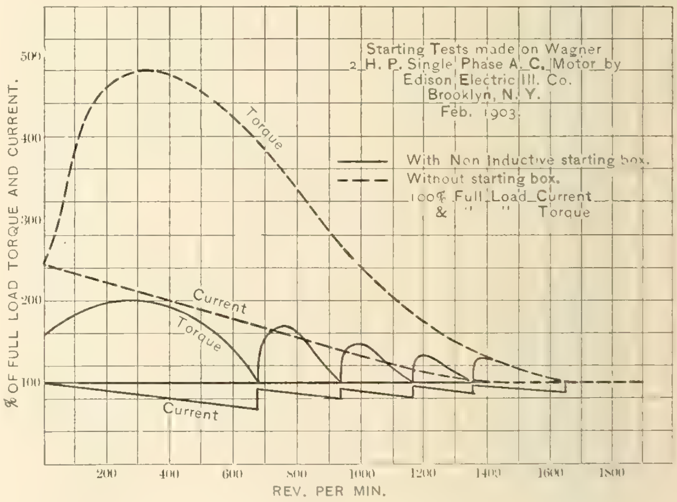


Fig. 3.

Great development has been made in the application of single phase motors by using non-inductive starting boxes for holding down the starting current. These boxes conform in general character to the usual direct current motor controlling rheostats. By their use motors of larger capacity may be used judiciously without injurious unbalancing effects on polyphase systems. The single phase motor built by the Wagner Electric Mfg. Co. possesses a starting torque characteristic when starting rheostat is not used, as illustrated in the broken curve in Fig. 3.

Instances are exceedingly rare where torque of this great magnitude is necessary to successfully start the load. Therefore a starting rheostat may be used and starting current held down to a low limit without sacrificing the necessary starting torque required for the usual installation. Fig. 3 illustrates a test made by one large company, in which full load torque was maintained from rest to full speed, without the current exceeding at any time the full load current. This is a better result than will be developed by the average motor, the manufacturers of the Wagner motor not claiming to be able to start full load torque in much less than 125 per cent. of full load current.

It is not necessary to dwell at any length upon the desirability of actively canvassing for motor load. Canadian stations are perhaps in advance of the average American companies in having for a number of years endeavored with great activity to secure a large load factor. The writer therefore believes that the operating engineer attending this convention will, without entering into the discussion in greater detail, accept this statement—that the single phase motor affords an exceedingly useful adjunct to the development of larger station earnings, by not only taking care of one form of business, which it has hitherto been difficult to take on, namely, the isolated power customer—but also by enabling the handling of a larger power business, even in the concentrated business districts at a lower first cost of installation, and therefore on the basis of a larger percentage of profit per horse power installed.

In concluding this paper, and for the benefit of those who are not especially familiar with the Wagner single phase motor, a description of that motor may prove of interest.

A great amount of time and thought has been devoted to the production of a commercially successful single phase motor. Early efforts to produce such a motor were broadly confined to two characteristic types—the synchronous motor, and second, the direct current motor, slightly modified to operate on alternating current. These efforts proved futile and no large degree of success in the production of a single phase motor was attained until the present form of induction motor, built by the Wagner Electric Mfg. Co. was placed upon the market. The motor consists essentially of a primary or stationary element, commonly referred to as the "field," and a secondary, or revolving element, commonly referred to as the "armature." These elements are entirely independent of each other. The current from the source of supply is fed into the field, and this induces all currents set up in the armature windings. In general terms, the armature may be said to be of the well-known direct current form, a progressive winding being connected to a radial commutator in the usual direct current armature fashion. Brushes are provided which, under usual circumstances, are short-circuited through the rocker arm, carrying them. In addition to these brushes there is placed within the annular opening of the commutator a short circuiting device, centrifugally controlled, the purpose of which device is to completely short-circuit the commutator, and through the commutator, the armature windings, when the armature has attained a predetermined speed of rotation. The motor is designed to operate in two distinct ways. First, with one combination of elements at starting, and second, with another combination of elements in the running condition. In starting, the induced currents of the armature windings are given a directional control through the brushes which results in a rapid accelleration of speed, up to what may be termed the normal operating speed. At this point the centrifugal device comes into play, forcing the short-circuiting links into the annular commutator opening. Simultaneously the brushes are removed from the commutator, and thereafter the armature revolves, performing its function in a manner quite similar to the ordinary polyphase motor. The motor is shown in cross section in Fig. 4.

The perfection of mechanical and electrical design of this motor is evidenced by its successful operation over a period of a number of years on almost all the leading central station systems of distribution. That the commutator arrangement meets satisfactorily the requirements of the service is evidenced by the fact that the Wagner Company has been building this form of motor for almost six years, and has not supplied up to the present time more than half a dozen renewal commutators, and this limited number of commutators was supplied to a single customer, who had installed a number of 30 H. P. motors to perform a special service involving an enormous number of stoppages daily.

At a number of conventions enquiry has been made as to the number of motors small stations can successfully operate. Instances are on record as follows:

One station, having a 75 K.W. generator has installed 100 H.P. in single phase motors. Another with 180 K.W. in generators, has 140 H.P. in single phase motors, and a third with 75 K.W. generator capacity, has 45 H. P. in motors. This form of motor adapts itself to all the usual kinds of small power work, such as pumping service, air compressors, printing presses, blowers, and small factory driving, coffee mills, belted elevators, storage battery charging, through the medium of motor-generator sets, etc. The type of single phase motor built by the Wagner Electric Mfg. Co. at the present moment is limited in application in only two ways, first, in the handling of work requiring a variation of speed, and second, in the handling of work calling for a great number of starts daily.

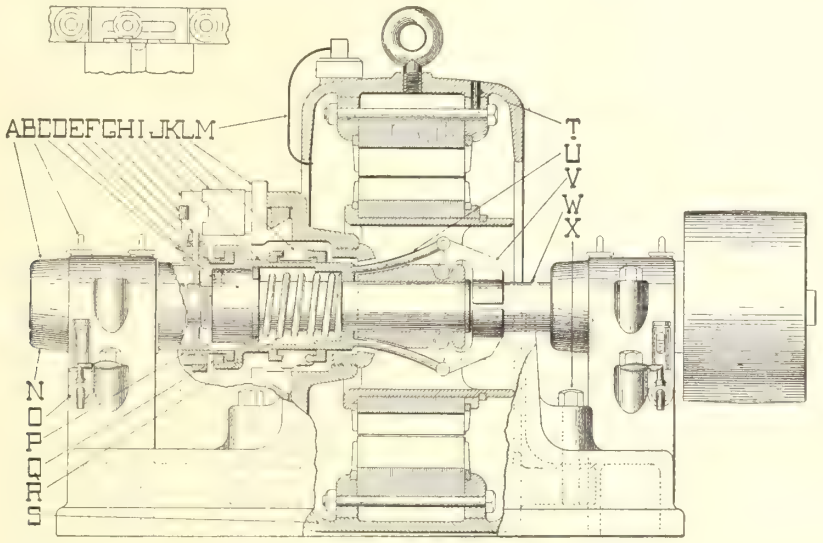


Fig. 4. Cross Section Open Type Motors.

A—Pillow Block Cap.
B—Oil Cover.
C—Rocker Arm.
D—Spring Nut Key.
E—Spring Nut.
F—Adjustment Stud.
G—Brush Holder Spring.
H—Carbon Brush.
I—Spring Barrel.
J—Brush Holder.
K—Short Circuiting Ring.
L—Commutator.
M—Terminal Cable.
N—Pillow Block.
O—Oil Cock.
P—Rocker Arm Tube.
Q—Spring Barrel Ring.
R—Govern or Spring.
S—Field Clamp.
T—Dowel Pin.
U—Governor Weight Pin.
V—Governor Weight.
W—Shaft.
X—Strap Bolt.

HIGH TENSION TRANSFORMERS.

By J. W. Farley

In a complete high voltage electrical power installation there are three distinct elements. These are: 1st, The generating plant; 2nd, the transmission line with its raising and lowering transformers; and 3rd, the apparatus for the distribution and application of the transmitted power.

Each of these divisions has its peculiar problems which must be met and solved, and each has its own special features. The first and third—the generating and distributing elements—have received more attention, perhaps, than the second—the transmission system. This is doubtless due to the fact that the rules and precedents governing the construction of a complete high tension system are not so well codified and as thoroughly understood as is the case in most other branches of electrical engineering The high tension installations already in successful operation have been designed and built by busy men who have not found time to lay before the public the valuable experience which they have acquired.

The present transmission line, with its raising and lowering transformers, constitutes the link between the generator, which may be located at some place where power is cheap, and the motor or rotary converter situated at the point where the energy is to be utilized.

It is axiomatic that with a given cost of conductor and a given loss the distance to which power can be transmitted depends upon the voltage. To raise the voltage to the figure demanded for economical transmission, and then to lower it to a pressure adapted for rotary converters, motors or lights, is the function of the high tension transformer, and it is on this account that it plays so important a part in the consideration and design of a long distance system of transmission.

The great progress in electrical power transmission which has occurred in the past few years is due in a measure to the advance made in the science of designing generators and motors and in the art of manufacturing them. It is, however, the development of the transmission system itself and especially of its high tension transformers which is the criterion of the great advance now being made in the electrical field.

In 1891 the company with which I am associated furnished transformers for the first long distance transmission installation in America. This was a 10,000 volt system between Pomona and San Bernardino, Cal. The groups of raising and lowering transformers were made up of twenty separate units, each wound for a high tension voltage of 500, the high tension windings being connected in series for 10,000 volts. The object of this was to divide the full voltage among many units, in order to insure adequate insulation between the coils and ground was obtained by heavy wrappings of insulating material and by the use of oil.

In 1895 experiments were undertaken on a high tension transmission line installed at Tulluride, Colo. Voltages as high as 60,000 were used and a great deal of valuable qualitative data was obtained. These tests were continued later upon an experimental high tension line at the Westinghouse Company's Works, East Pittsburg, when a long and careful series of measurements was made under varying conditions.

The manufacture of high tension transformers has been going on continuously for several years and on the whole so successful has been their operation and so marked have been the improvements in the design and construction of the higher voltage transformers, that to-day consulting engineers and prospective builders of transmission lines have become accustomed to the use of voltages of 40,000 and 50,000, and are seriously considering voltage as high as 60,000. No little confidence, of course, has been established by the successful operation of several high voltage systems in the West, notably the plant of the Missouri River Power Company, which transmits energy at 50,000 volts from Canyon Ferry to Helena and Butte, distances of 17 and 65 miles respectively.

Mention is so frequently made to-day of transmission at voltages in the vicinity of 50,000, and so many projects are being planned which embody transmission lines of approximately this voltage, that the successful inauguration early this year of a 50,000 volt line almost one hundred miles in length did not attract the attention it would have done even twelve months ago. I refer to the transmission system of the Shawinigan Water and Power Co., extending from Shawinigan Falls on the St. Maurice River, P. Q., to Maissonneuve, a suburb of Montreal. Since the middle of February this line has been delivering energy generated at Shawinigan Falls to Montreal, ninety miles distant, at a pressure of 50,000 volts. From the time this line was first thrown into service no shutdowns whatever have occurred.

The generating plant and the transmission line each merit detailed description. It is the purpose, however, of this paper to describe only the transformers as typical of the latest and best engineering practice in the design of high tension apparatus.

The raising transformers are designed to step up from the generator pressure, 2,200 volts two-phase, to 50,000 volts three-phase. The lowering transformers step down from 44,000 volts three-phase (allowance being made for a line drop of 12 per cent.) to 2,400 volts three-phase, two transformers being connected in "T." Taps for 86.7 per cent. are provided in both the high tension and the low tension windings; since two transformers connected in this way have a slightly higher efficiency and a better regulation than they would if connected either in "V" or in "T" with the full windings of both transformers in use.

No reference has as yet been made to the capacity of either the raising or lowering transformers. In the rating of these units lies one of their special features, well worth mentioning at this time.

The generating plant at Shawinigan Falls was designed with the idea of furnishing power at 2,200 volts to industrial establishments in the immediate vicinity. For the power service contemplated a frequency of 30 cycles was chosen.

When the plans for the transmission lines to Montreal were made it was decided to use the 30 cycle generators already installed, transmitting at that frequency and changing at Montreal to the frequency in use there (60 cycles) by means of motor-generator outfits. Future contingencies were, however, kept in mind and it seemed advisable to have the high tension transformers so built that at a later date, if desired, 60 cycle generators could be installed at Shawinigan Falls and the company's Montreal customers supplied with 60 cycle current direct from the secondaries of the step-down transformers. In fine, the transformers were to be designed for operation at either 30 or 60 cycles.

This was done in the following manner: A design was made for a 30 cycle transformer of the specified capacity (1,110 K. W. for the raising and 1,000 K. W. for the lowering), the characteristics being such that high efficiency and good regulation would be obtained. Both high tension and low tension windings were made in two equal parts, with terminals arranged for either series of multiple connection.

For 30 cycles the windings were designed to be connected in series. For 60 cycles, however, the two parts were to be connected in multiple, the same voltage being applied to but half the number of turns. The result of this is that while each part will carry the same amount of current as with the 30 cycle connection, the two parts together will deliver twice the amount of current with the same copper loss and at the same voltage as before, thereby doubling the capacity of the transformer.

Thus while the raising transformers have a capacity of 1,110 K. W. for 30 cycle operation, they are rated at 2,220 K. W. for 60 cycles and the lowering transformers are likewise rated at 1,000 K. W. and 2,000 K. W. for 30 and 60 cycles respectively.

Operating at 60 cycles the transformers will deliver their rated output (2,200 K. W.) with an ohmic drop only one-half of that for full-load at 30 cycles. The inductive drop will be the same under either condition. The regulation, therefore, at 60 cycles is better than at 30 cycles, the exact figure in the case of the raising transformer being for loads having a power factor of 100 per cent. the extremely low value of 0.376 per cent.

With the number of cycles increased by 100 per cent. and the number of effective turns decreased by the same amount, the flux density in the magnetic circuit will be the same, the loss per cycle being slightly more at the higher frequency than at the lower. The iron loss is, therefore, a little more than double at 60 cycles. Its percentage value, however, is increased but very little. The accompanying efficiency and regulation curves will show clearly the effects of the different arrangements upon the performance of the transformer.

In the preliminary consideration of these transformers, there was but little choice concerning the general type to be employed. With the construction used at present in the air blast transformers, the limit of its voltage is in the neighborhood of 25,000 or 30,000. The oil-insulated transformer, however, has been built for voltages far in excess of those now in commercial use, so that the voltage of transmission lines of the future will not be determined by the limitations of the transformers.

For voltages above 30,000, then, we are safe in saying that the feature of oil insulation is essential. For transformers of small capacity the cases may be designed with a surface of such an area that natural radiation will keep the temperature of the transformer at some conventional figure. The cost of this radiating surface increases, however, as a high power of the increase in capacity, so that for large transformers recourse must be had to artificial cooling of some kind.

In the Shawinigan transformers the heat is removed from the oil by means of the conventional cooling coils, through which water is circulated. These coils are of brass tubing and have no joints nor connections of any kind inside the case, so that the danger of leaks is reduced to a minimum.

The Shawinigan transformers are placed in an upright position in boiler iron cases. A more detailed description of these cases will be given later. Both high tension and low tension leads are brought out through the case iron tops, long specially made tubes of fullerboard and mica being used for the high tension conductors.

The coils of these transformers are wound up in sections of only one turn per layer. The turns are well insulated from each other and the several coils and sections are protected by wrappings and washers of heavy insulation. A very generous provision is made for ventilating ducts between the sections and between the laminae of insulations. There has been a tendency in the design of some transformers to overlook the fact that there are losses generated in the insulation and that in high tension transformers some provision must be made to dispose of the resulting heat. Careful attention was given to this point in the transformers in question and the insulating material, as well as the copper itself, is kept at a temperature only slightly higher than that of the oil. This point was proved by careful exploration with thermometers during the tests.

The ducts through the windings are vertical, so that when a transformer is operated a pronounced chimney effect is produced, the oil rising to the top with such a velocity that the surface of the oil is visibly disturbed.

The iron laminations are also separated at frequent intervals by ventilating ducts, which permit the oil to circulate to within less than an inch and a half of every part of the magnetic circuit.

The low tension leads from the coils are brought direct to a heavy marble terminal board, so arranged with studs and connectors that the somewhat complicated combinations referred to earlier can be easily and quickly made.

The terminal board for the high tension leads presented a more difficult problem; its solution was found, however, in the use of standard porcelain insulators mounted on pins and cross arms. Since the insulators are under oil a compact arrangement was effected which has the merit of making this one of the strongest points in the transformer.

The cases of all these transformers are provided with sight gauges at the top to show the height of the oil level. Gauges are also placed at the bottom of the case in order that the presence of water may be detected.

A thermometer is furnished with each transformer, its bulb extending into the oil just below its surface. This thermometer has electrical contact devices, whereby an alarm may be sounded in case the temperature of the oil exceeds any predetermined value.

Too little attention has ordinarily been paid to the consideration of adequate means for handling large transformers. In some instances no provision is made, a great deal of temporary rigging being required in order to install the transformers or to remove them from their cases for inspection or repair. Sometimes a travelling crane is provided which renders the lifting of the transformers very simple. Both the temporary lifting device and the crane, however, interfere very seriously with any high tension wiring which may be located above the transformers. Inasmuch as the logical position for the high tension wires is overhead, any method of handling the transformers which will not interfere with this wiring or which could be employed while the wiring is alive, is of decided advantage.

Each of the Shawinigan transformers is placed upon a heavy cast iron base which normally rests upon six flanged wheels let into the foundation proper, cast in the bottom of the base.

In front of the transformers parallel with the line in which they are placed is a track on which is a shifting or transfer truck supplied, in addition to the four wheels on which it moves, with six wheels placed in exactly the same manner as those on the transformer foundation. When for any reason a transformer is to be removed from its case, the truck is run up directly in front of the transformer, from which the leads and piping have been disconnected. The transformer, moving easily on the fixed wheels, is then pulled out on the truck. The truck and transformer may then be moved to a point beneath a permanent hoisting device.

If a travelling crane has been installed for other apparatus in some other part of the building, the above scheme can ordinarily be employed to bring the transformer within range of this crane.

A novel feature was introduced into the design of these transformers which lessens to a great extent the risk to surrounding property from the presence of the quantities of oil in which the transformers are immersed. This scheme, which was suggested by Mr. R. D. Mershon, involves the safe and rapid transfer of the oil to a place of safety in case of fire in the transformer building.

The transformer cases are made of heavy iron. The top is of cast iron, heavily ribbed and arranged to bolt to the tank, an air-tight joint being effected by means of a lead gasket. The manholes in the top are also made with air-tight joints, and all the leads and cooling coils are brought out through the stuffing boxes. At the bottom of the tank is placed a large valve which connects direct with the water mains. If a fire occurs in or near the building in which the transformers are housed and apprehension is felt lest their cases be damaged and the oil be ignited from the heat of the burning building, the emergency water inlet valve may be opened and the oil forced out of the top of the transformer into the sink hole. In this place it will be safe from destruction and the danger of great damage to surrounding property through the release of hundreds of gallons of burning oil will be averted. The substantial construction of the case, together with the water which will then fill it, will protect the transformer itself from harm, the only damage liable to occur to the transformer being the wetting which it will receive. A wet transformer, however, may, by proper treatment, without any great difficulty, be put again into condition for operation.

In the construction of large high tension transformers many serious problems are encountered. In addition to the difficulties incident to the winding and assembling of large coils, and the care which must be exercised in handling the quantity of insulation required, the question of keeping the insulation in good condition during manufacture, shipment and installation is perhaps one of the most important problems. The presence of moisture is fatal to the insulating properties of the best material which can be obtained. Even with the utmost care during manufacture, a certain amount of moisture invariably finds its way into the insulation. Some method must be devised then to thoroughly remove this before the transformers can be in the proper condition for operation.

Inasmuch as it is inadvisable and impracticable to ship large units in their cases and under oil, the plans for removing this moisture must comprehend the drying out of the transformers at the point of installation and immediately before the oil is placed in the cases.

A striking example of this was presented by several of the transformers shipped to Montreal and to Shawinigan Falls. These transformers left the States in December, arriving in Canada at one of the coldest periods of the winter. Before they arrived at their destination the weather suddenly moderated and the atmosphere was heavily impregnated with moisture. The transformers were, however, at a temperature many degrees below freezing point and on being unpacked were found to be entirely covered with a white frost to a thickness of from 3-8 to 3-4 inches. The weather continuing warm, this frost gradually melted, leaving a considerable amount of water throughout the transformers.

The manner in which these transformers were successfully dried out will no doubt prove interesting at this time.

As soon as possible the transformers were placed in their cases without oil and the tops put in position. The low tension windings were short circuited through the high tension windings. Thermometers were placed at those points which might be expected to develop the highest temperature under these conditions of heating. These thermometers were very carefully watched and the current was so regulated that the actual maximum temperature remained in the vicinity of 100 degrees C. At this temperature both oil and water vapors were thrown off in great quantities.

Energy at 500 volts direct current was available and electric heaters, accommodated to this voltage, were designed and made. These heaters were enclosed in sheet iron boxes and connection was made between them and an opening at the bottom of the transformer case by means of ordinary stove pipe. The heaters delivered to the transformers a great volume of air heated to a temperature of almost 200 degrees C. Baffle plates were placed inside the transformer cases so that the hot blast might not blow directly against either the coils or the insulation.

The hot air rose from the bottom of the case to the top, pouring out of an opening left in the cover. This circulation of hot dry air tended to remove from the inside of the case the vapors expelled from the interior of the transformer by the heat generated there.

This process was continued for several days. Measurements of the insulation resistance were taken from time to time until the results showed that the transformers were in even better condition than they had been when they successfully underwent the puncture and over-potential tests of 100,000 volts.

While the transformers were still hot the oil was placed in the cases and an increased current circulated through their windings. The quantity of this current was such that the heat generated in the windings was sufficient to maintain a fairly vigorous circulation of oil through the interior of the transformer.

No trouble was encountered in bringing the transformers up to full voltage for the first time and nothing has since arisen which indicates that the insulation is in any other than first-class condition.

This paper would not be complete without at least a reference to another important Canadian power transmission. The Montreal Light, Heat and Power Company transmits power from its generating plant on the Richelieu River to Montreal, eighteen miles distant, at 25,000 volts.

These transformers have the greatest capacity of any transformers ever built, namely, 2,750 K. W. The step down station of this line is in the heart of the city of Montreal, and owing to city ordinances prohibiting the storage of quantities of oil within the city limits, the air blast type was chosen.

These transformers are of the same general construction as the Shawinigan, except of course that they are not placed in cases, but are provided with a neat cast iron housing. The air is forced through ducts placed between the coils and between the iron laminations in a manner analagous to the natural circulation of oil through the ventilating ducts of an oil-insulated transformer. The amount of insulating material used is, of course, greater than in transformers of the oil type designed for the same voltage.

Up to the time of the unfortunate accident to the dam at Chambly these transformers and the transmission line gave a service highly satisfactory in all respects.

In bringing this paper to a close it may perhaps be no more than fair to say that the special emphasis laid upon the transformers of the Shawinigan Water & Power Company is due to the fact, not generally realized, that the Shawinigan transmission system stands as chief of the three most prominent long distance, high voltage systems in the world, exceeding one of them in voltage and one in length of line; and to the fact that these transformers present the latest and best features, electrical and mechanical, of good transformer design.

BOILER INSPECTION.

The last annual report of the Inspector of Factories for Ontario contains the following chapter on "Boiler Inspection," over the signature of Mr. James T. Burke:

Thorough boiler inspection is only possible under government supervision; while we have some powers under Section 20 (g) of the Ontario Factories Act, yet we occasionally receive reports of boiler explosions which do not apply under the Act. A boiler explosion usually carries with it a loss of life, as well as destruction of property, and I would recommend that the law be so amended that all boilers in the Province of Ontario be inspected and tested by some authorized representative persons, who will follow the modern practice of ascertaining whether boilers are safe in places which do not come under Section 20 of the Factories Act or the Boiler Inspection Company of the province.

Boiler inspection is usually regulated under the following order:

No. 1. Hydrostatic tests.
No. 2. External inspection.
No. 3. Internal inspection.

Mr. J. J. Wright,
President Canadian Electrical Association.

The Hydrostatic tests consist in applying a cold water pressure to a boiler that is completely filled with water, after which the inspector looks the boiler carefully over in all parts to see if there are any signs of leakage, or distress of any kind. This test is usually applied to new boilers or boilers that have undergone extensive repairs. This test is not considered to be injurious to a boiler when it is applied by a man with good judgment. The hammer test is recommended also when it can be applied.

External boiler inspection is made by looking the boiler over from outside to make sure that the attendants are not running it at a higher pressure than is allowed, that he is carrying plenty of water in the boiler, that the safety valve will blow off freely and at the pressure it is allowed, that the water gauges are in safe condition, that the boiler is not showing any signs of leakage or any bulges over the fire sheet, or signs of distress of any kind.

Mr. K. B. Thornton,
First Vice-President Canadian Electrical Association.

Internal boiler inspection, or hammer tests, as they are sometimes called, is made by the inspector entering the boiler through the manhole and looking the inside over carefully as well as the outside of the boiler. Among the things that he has to look out for are these: A deposit of sediment or muddy matter, hard incrustation or scale on the tubes and plates, corrosion of any part of the boiler, both inside and outside fractures of the plates, heads, headers, etc., leakage around the tube ends, seams, and all other places where such leakage is possible, defective bracing of the flat parts of the boiler, grooving of the plates or heads, burned or blistered parts, defective accessories of all kinds, water gauges, feed pipes, blow pipes, steam pressure gauges and safety valves.

Mr. A. A. Wright,
Second Vice-President Canadian Electrical Association.

We frequently find that a steam gauge has not been tested for several months, which is wrong on account of the delicacy of its construction; a great deal depends upon its accuracy. Moreover, safety valves are sometimes found weighed down with scrap material, and they occasionally stick, when it is difficult to tell whether the gauge or pop is correct. Such incidents as these help to explain some of the unaccountable boiler explosions, which upon subsequent investigation have shown neither low water nor bad stay-bolts. Owners should purchase the very best steam pressure gauges which is the general practice, and they should be tested frequently while in use. With the gauge correct, the safety pop valves should be frequently set, and any sticking should receive prompt attention

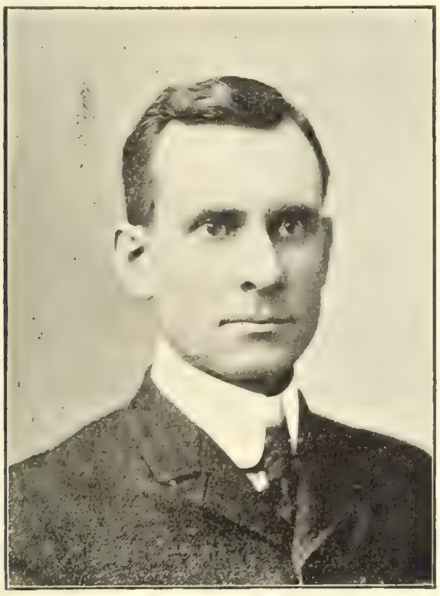
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The twentieth annual convention of the American Institute of Electrical Engineers was held at Niagara Falls, N. Y., from June 29th to July 3rd. Not only was there a record attendance, but the whole week was a continual round of business and pleasure combined. Over five hundred of the foremost electricians on the continent registered in the first two days alone. Representatives were present from Great Britain, France, Belgium, Germany and Canada.

The headquarters of the convention were at the Cataract House, whilst the various business sessions were held at the Natural Food Company's Hall.

The large number of distinguished men present included representatives from Cornell University, the University of Illinois, Iowa State College, Lehigh University, University of Missouri, Ohio State University, Pennsylvania State College, Purdue University, and the Western University of Pennsylvania. Cornell and Purdue were in special evidence.

The first included an address from the President, Chas. F. Scott, of Pittsburg, addresses of welcome from the Mayor and local bodies : papers on Institute branch meetings ; energy transformations in the Synchronous Converter, and commercial alternator designs, with exhaustive plans and blackboard illustrations sketched upon the spot by the leading men in their line.



Charles F. Scott, Pittsburgh, Pa.,
President American Institute Electrical Engineers.

In the afternoon the Niagara power houses, the historic Falls and Rapids, and the various points of interest were visited. An exhibition of the Hewitt Converter and the Mercury Vaper Lamp, was given in the evening by Prof. Thomas. This was a wonderful demonstration of several things made public for the first time. A female brass band and orchestra enlivened the proceedings.

Tuesday was Electric Railway day and confined principally to railroad papers given by the leading experts, including high speed problems, storage battery industrial locomotives, predetermination in railway work, car run tests, electrical and mechanical specifications for trolley line insulators, the storage battery in sub-stations, and operation of railway motors in service.

In the afternoon a technical tour of inspection was made of the electro-chemical and other electrical installations operated by Niagara power, with a grand reception and luncheon given by the Niagara Power Company. In the evening a dance was held at the Cataract House.

The papers for discussion on Wednesday were on the test of electrical apparatus for dielectric strength, choice of frequency for very long lines, methods of bringing high-tension conductors into buildings, Y or Δ connection of transformers, the grounded wire as a protection against lightning, the operation and maintenance of high-tension underground systems, electric cables for high voltage service and the use of automatic means for disconnecting disabled apparatus.

In the afternoon trolley trips were made to Niagara Gorge and Brock's monument, the evening being given over to a magnificent garden party and entertainment at the Cataract.

Thursday and Friday was a continuance of the valued papers and most thorough debate thereon. Technical trips by trolley and otherwise were taken also to see an illumination of the whirlpool rapids at night.

A feature of the convention was the ride along the river on decorated flat cars of the Niagara Falls and Buffalo line with stoppages at the various plants en route.

J. R. H.

THE MONTREAL LIGHT, HEAT & POWER COMPANY.

According to the second annual report of the Montreal Light, Heat & Power Company, submitted at the meeting of shareholders on June 5th, the gross earnings of the company for the fiscal year ended June 30th, 1903, amounted to $1,937,560.57, and the net profits to $718,667.51. There were declared four quarterly dividends of 1 per cent. each, which left a balance of $39,333.51, which was placed to the credit of surplus account.

The Queen street station was during the year remodelled and made thoroughly fire-proof, thus reducing the cost of insurance.

Owing to the break in the Chambly dam the company suffered a loss in revenue and an increased operating expense estimated at $153,351.37. When the reconstruction of the dam is completed the company will have 1,600 additional horse power.

During the year 17,806 incandescent lamps, and motors equivalent to 5,093 horse power, were added to the company's circuits, exclusive of the companies recently acquired.

There were installed during the year 3,565 gas and 465 electric meters, 2,305 gas stoves and 1,338 new services, and 7.3 miles of new mains were laid.

The Dominion Government have granted incorporation to the Chatham, Wallaceburg & Lake Erie Railway Company, to construct an electric railway from Rondeau to Wallaceburg, with a branch from Charing Cross to Blenheim. The incorporators include George Stephens, N. H. Stevens, W. E. McKeough and William Ball, of Chatham.

The Electrical Development Company, of Ontario, Limited, are calling for bids for the construction of a wheel pit and two tail race branch tunnels at Niagara Falls. This company has been formed for the purpose of undertaking development work originally contemplated by the Toronto & Niagara Power Company. The wheel pit about to be constructed will be 480 feet long, 180 feet deep and 27 feet wide, cut through solid rock.

TRADE NOTES.

The Dominion Motor & Machine Company, Toronto, has been succeeded by Power Accessories, Limited.

The Eugene F. Phillips Electrical Works, of Montreal, have just opened a Toronto office at 50 Adelaide Street West, with Mr. J. P. Thompson in charge. The company intend to give greater attention to their western trade in future.

The R. E. T. Pringle Company, Limited, of Montreal, through their St. John branch, have been awarded the contract to equip the steamer Beatrice Waring with an electric light plant and search light. The plant will consist of an 11½ k. w. Crocker-Wheeler generator, which will supply the current for 110 lights and the search light, and a Leonard automatic engine.

The Westinghouse Traction Brake Company, 26 Cortland St., New York, has recently received from the St. Louis Transit Company, St. Louis, Mo., an order for from fifteen hundred to two thousand air brake equipments for street railway service. This is claimed to be the largest single order for air brakes for electric railway cars ever placed in the United States or abroad.

A novel application of induction motors is to be made by the Belleville Portland Cement Company in their cement plant at Belleville, Ontario, which is to be equipped throughout with Westinghouse electrical apparatus. A recent order placed with the Westinghouse Electric & Manufacturing Company comprises two 450-kilowatt, engine-type alternators, one 100 kilowatt, D. C., engine-type generator and a motor-generator set consisting of a 100 kilowatt, D. C. generator and a 150 horse-power, three-phase, type C induction motor. These two D. C. machines are to be used for exciting the fields of the A. C. generators, for supplying lighting circuits and for the operation of a tramway locomotive. Sixty-two induction motors will supply the motive power. These include forty-six type C constant speed motors, ranging in capacity from 10 to 50 horse power; ten type F, variable speed induction motors, each to be direct geared to a rotary kiln and provided with a controller permitting the operation of the motor at any one of four speeds; two type F motors, each to be direct connected to a hoist and provided with standard non-reversing hoist controller; also four 400 volt, type C variable-speed induction motors for the operation of two overhead travelling cranes, these being provided with reversible crane controllers. Included in the equipment is a Baldwin-Westinghouse mining locomotive for operation on a 24" gauge track with double trolley. The ten-panel switchboard consists of two generator panels, three A. C. feeder panels, a double exciter panel, a D. C. feeder panel for the control of the tramway circuit and another to control the circuits of the generator fields, and two D. C. feeder panels for the lighting circuits. Altogether this will be a novel and interesting plant, as the operation of rotary kilns by direct connection to variable speed induction motors is a new departure from the usual method of supplying power to this class of machines.

NOTES OF THE C. E. A. CONVENTION.

The Bullock Electric company registered all in attendance, giving each a numbered bntton and a metal souvenir badge.

Everybody, and the older members of the Association in particular, were pleased to see at the C. E. A. convention the familiar countenance of Mr. C. F. Medbury, who is now with the Westinghouse Company at Detroit.

The Canadian General Electric Company gave away to the visiting members and ladies a beautiful souvenir badge in the form of a minature arc lamp attached to a red, white and blue ribbon. The demand for these novel souvenirs was very great.

Other invitations received were from the Chapman Double Ball Bearing Company and the Henderson Roller Bearing Company, both of which had special exhibits prepared for the Convention, which were visited by a large number of the street railway men, who saw in these exhibits a great saving of power.

The dinners given in the grill room by the Westinghouse and Bullock companies, and the hospitality shown to the delegates by the Richmond Conduit Company, Howarth & Sadler, Chapman Double Ball Bearing Company, and the Canadian General Electric Company, were of such excellent quality as to make the members yearn for the coming of another convention.

Several photos of the Convention were taken. Among the ladies in attendance were Mrs. J. E. Skidmore, Cobourg; Mrs. W. H. Breithaupt, Berlin; Mrs. Saxby, Bowmanville; Miss Belle Maunder, the Misses Haworth, Miss Howland, Toronto; Miss F. A. Reesor, Lindsay; Mrs. J. W. Purcell, Walkerville; Mrs. C. H. Mortimer, Toronto; Mrs. Bowlby, Berlin; Miss Boyd, Berlin; Miss Reagan, Cincinnati; Mrs. Evans, Quebec; Mrs. R. J. Parke, Toronto, and a number of others whose names we were unable to learn.

Mr. G. R. Duncan, M. Sc., superintendent and electrician of The Montreal Pipe Foundry, was married in Ottawa recently, to Miss Florence Benedict.

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MONTREAL

SPARKS.

By a vote of 5 to 4 the council of Fredericton, N. B., have decided to install a municipal electric light plant.

The City Council of Winnipeg, Man., are considering a proposition for establishing a municipal telephone system.

The Bell Telephone Company have recently completed a long distance telephone line on the south shore of the Ottawa River.

The Bell Telephone Company are installing a metallic service in Parry Sound, Ont. The local manager there is Mr. R. Weiler.

The Sarnia Gas & Electric Company, Sarnia, Ont., have been given permission to increase their capital from $75,000 to $225,000.

The bill of the town of Listowel, empowering the council to purchase the electric light plant has been passed by the Ontario Legislature.

Mr. William O'Leary, electrical engineer, of Montreal, is installing in St. Joseph's University at Memramcook, N. B., a complete electric light plant.

His Majesty, King Edward, has given instructions to have electricity installed throughout his residence at Sandringham, to replace gas lighting, which has heretofore been in general use.

A company is being formed by Mr. S. V. Nicholls Halstead, manager of the Snmmit Lake Mining Company, to construct a telephone line between the Manitou Mines and Dinorwic, Dryden, Wabigoon and Goldrock, Ont.

The Wallingford Mica & Mining Company, composed of American capitalists, have established a mica factory in Ottawa in which fifty hands are employed. Mica mines in Templeton and Hull townships are being operated.

Financial arrangements have been made for a considerable extension of the lines of the Havana Electric Railway Company, in which Canadians are largely interested. Mr. Edwin S. Hanson, of Montreal is President of the Company.

A large double truck car of the Montreal Street Railway left the track on St. Antoine Street and crashed into a cigar store, breaking doors and windows and scattering the goods in the store. Although there were upwards of 50 people in the car no one was injured.

Mr. L. T. Barclay, of Whitby, Ont., has made application to the Dominion Parliament for the incorporation of the Algonquin Lumber & Power Company, to conduct a general lumbering and manufacturing business and to generate electricity.

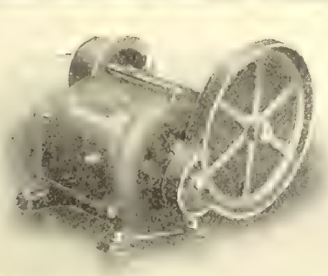
The West Isle Telephone Company, Limited, has been incorporated, to provide a telephone system on Deer Island, Charlotte County, N. B. The promoters include Messrs. Fred A. Richardson and W. A. Randall, of Deer Island.

As the result of an explosion in the east end station of the Montreal Light, Heat & Power Company, Napoleon Marian, fireman, was killed, and John Schwab, fireman, seriously injured. A report on the accident will be made by E. O. Champagne, boiler inspector.

The People's Rapid Transit Railway Company, of Toledo, Ohio, have awarded a contract to Morrison, Fowler & Scott for grading, covering the route between Napoleon and Defiance. The plan is to build north from Cincinnati and south from Toledo. The project contemplates a road 220 miles long. It is probable that the name of the company will be changed to the Toledo & Cincinnati Short Line Railway.

The Montreal Street Railway are studying the formation of a mutual benefit association among the employees, and are in communication with several companies having such an association in successful operation. The objects are to bring the men in closer touch with the management and to create a fund for relief of the sick and injured, to give assistance to widows and children and to provide pensions for those who have grown old in the service.

The annual meeting of the Canadian Telephone Company was held at Sawyerville, Que., recently, when very satisfactory reports were submitted. The company now have 482 telephones, distributed as follows: Sawyerville, 105; Cookshire, 184; Bishop's crossing, 46; Lake Megantic, 45; Bury, 42; St. Malo, 33; Angus, 29; Marbleton, 27; Paquette, 27; La Patre, 22; Scottstown, 13; Milan, 9. The miles of poles are 275 and of wire 546.



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BROTHERHOOD OF ELECTRICAL WORKERS.

A largely attended conference of the Canadian members of the International Brotherhood of Electrical Workers, was held in Toronto on July 4th. Delegates were present from London, Ottawa, Winnipeg, Sault Ste. Marie, Hamilton, St. Catharines, Quebec, Montreal, Toronto and other places, representing over three thousand members.

Mr. H. J. Hurd, Grand Vice-President of the International Union, presided. The conference endorsed the passing of by-laws for towns and cities making it compulsory for all electrical workers to pass a competitive examination as to proficiency for the safety of the public. A warm discussion was held over the efforts that are now being made to nationalize all Canadian unions and sever their International relations, and a motion endorsing the actions of the International Brotherhood and pledging the hearty support of the Canadian conference for the future was passed unanimously.

SPARKS.

A by-law will be submitted to the ratepayers of Guelph, Ont., for the purpose of taking over the electric street railway.

Mr. E. Shipton, of the Vancouver Electrical Works, has submitted a proposition to install an electric plant for the corporation of the North Vancouver, B. C.

Correspondence from Fort William, Ont., states that F. H. Clergue has announced his intention of at once developing the water power of the Kakabeka Falls.

New tenders have been invited for supplying electric power for the City of Winnipeg, t he companies tendering to submit their own specification.

Mr. William C. Campbell, President of the Detroit Trolley Wheel & Electrical Equipment Company, recently visited Toronto and other cities with the object of forming a Canadian company for the manufacture and sale of Potts' trolley wheel and other articles.

At the annual meeting of the Laurie Engine Company, Montreal, held last month, the old board of directors was re-elected, as follows: President, C. E. L. Porteous; Vice-President, William Yuile; John Laurie, F. L. Wanklyn, C. W. Davis, Walter H. Laurie and W. G. Ross.

The Nova Scotia Telephone Company held its annual meeting in Helifax last month. The total earnings for the year were $111,007.83 and the expenses $79,163.77, leaving a bolance of $31,844.06. A dividend of 6 per cent. for the year was declared. The number of instruments under rental is 2,969. Forty-five miles of pole, 146 miles of copper wire and 33 miles of iron wire have been added to the long distance.

Frank Van Tuyl & Company, electrical engineers, of Detroit, hove submitted to the council of Windsor, Ont., a report on the electric plant in that town. They recommend the installation of new generators, transformers, switch-boards and arc lamps, at an approximate cost of $8,580. They point out the the efficiency of the the old type of arc lighting machine is only 64, whereas that of the new type would be 93.

The annual meeting of the New Brunswick Telephone Company was held at Fredericton on June 9th. The usual dividend of 4 per cent. on the capital stock was declared. It was decided to string a copper metallic line from Fredericton to St. John and from Moncton to St. John. The officers chosen for the ensuing year are as follows: President, Hon. A. G. Blair; vice-president, J. L. Black; managing director, Senator Thompson; secretary and treasurer, W. E. Smith.

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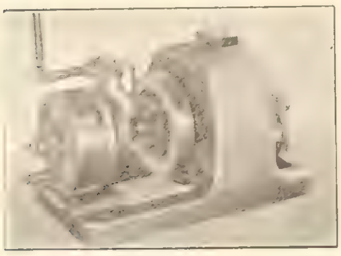

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Compact and light—space and weight minimized.

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SPARKS.

The Winnipeg Electric Company have secured the contract for electric wiring the new Pinkham in Winnipeg, their tender being $236.

The Owen Sound Iron Works Company, Owen Sound, Ont., are building a large addition to their foundry and intend installing an electric light plant.

The Sherbrooke Light, Heat & Power Company, of Sherbrooke, Que., have refused to accept the offer of the city for the purchase of their plant.

The Robb Engineering Company, of Amherst, N. S., will issue $100,000 additional capital, the money being required to make extentions to their present works.

It is stated that the DeForest Wireless Telegraph Company will establish a station at Sault Ste. Marie, Ont., on land provided by the Lake Superior Consolidated Company.

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SITUATION WANTED

A strictly temperate Young Man, (age 19), a student of an electrical correspondence school, desires situation to combine theory with practice. Would take position with Electrician, or with Electric Construction, Repairing, Manufacturing or Telephone Co., or any other branch of the electrical profession where good chance is offered. Have had no experience. State parparticulars and wages to begin with, address "L," Box 28, Listowel, Ontario.

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1–75 K.W. S.K.C. Generator, 2000–1000 volts, 8000 alternations, with 2½ K.W. Exciter and Station Apparatus complete.

1–5 H.P. S.K.C. Motor, 8000 Alts., 500 volts, with necessary Transformer 1000–2000–500.

1–25 K.W. R. E. Co. B-iPolar D. C. Dynamo, wound for 110 volts, with sliding base, pulley, brushes, etc., complete.

2–12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.

The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address

THE VOLTA ELECTRIC STORAGE CO.,
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SPARKS.

The corporation of Annapolis Royal, N. S., is about to engage a superintendent for the electric light system.

The C. P. R. Telegraphs have been compelled to build a new line between Toronto and Hamilton to handle the increased business.

Mr. Robert A. Ross, E. E., of Montreal, has valued the plant of the Perth Electric Light Company, which the council desire to take over.

The Town Council of Port Arthur, Ont., have instructed Mr. Russell, C. E., to report on the development of the Current River water power.

Messrs. Steinhoff & Gordon have purchased James Murphy's water power in connection with the electric plant to be established at Tweed, Ont.

The Memramcook & Dorchester Telephone Company held their annual meeting at Memramcook, N. B., last month, at which it was decided to extend and improve the lines of the company.

The Chasm Power Company has recently been organized to develop a water power near Chateauguay, Que. Mr. William Johnston, Jr., manager of the Chateauguay Pulp Company, is one of the promoters.

The shareholders of the Ottawa Valley Railway, at a meeting held in Montreal on June 9th, decided to purchase the Carrillon and Grenville Railway. extend the present line from St. Andrew's to Carrillon and equip the whole road with electricity.

The directors of the Toronto Railway Company have decided to greatly increase the power plant, in accordance with a report made by a New York expert. The intention is to provide from 6,000 to 10,000 additional horse power, some of which will be needed for various anticipated radial extensions.

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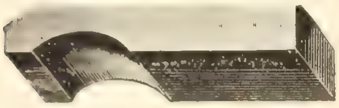

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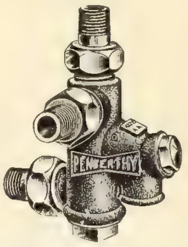

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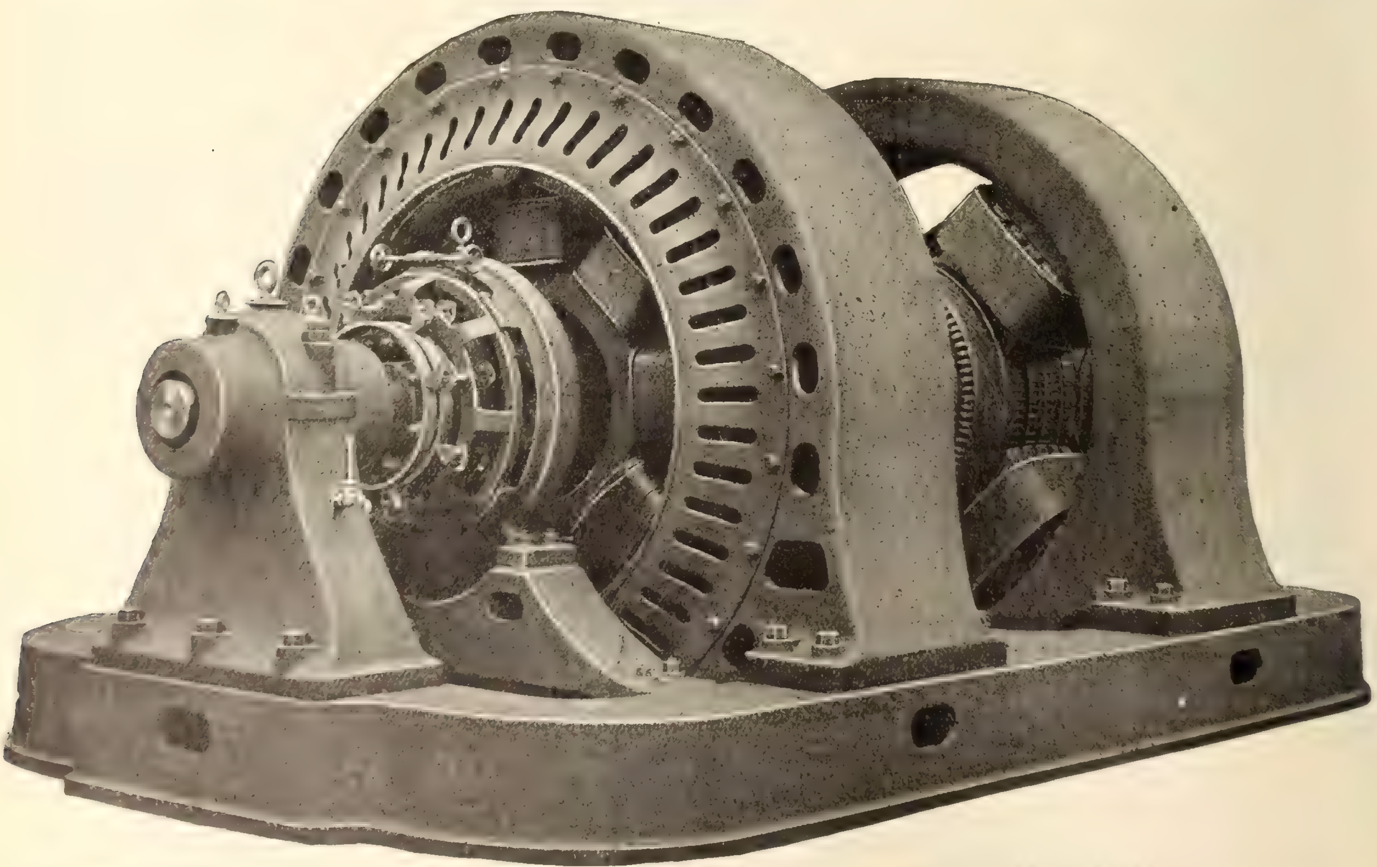

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SPARKS.

The town of Moosomin, N. W. T., offers a good opening for the establishment of an electric plant. Mr. John Smithers, secretary-treasurer of the corporation, will give particulars.

United States Consul F. W. Mahin writes from Nottingham, that the city of Derby (population about 110,000) has decided to substitute electricity for its present inferior horse-tramway system. The sum of $440,000 has been appropriated for the purpose as a beginning. The length of road now contemplated exceeds 6 miles. The overhead trolley will be used.

Mr. Frederick Thorne, of the Westinghouse Electric & Manufacturing Company gave out the following statement while attending the Convention of the Canadian Electrical Association in Toronto: "The great industry of George Westinghouse is about to be established in Canada on a large scale by the formation of a Canadian Westinghouse Company, capitalized at $2,500,000, and the construction of large works, on a site to be selected, in one of the manufacturing towns in the province of Ontario. It is proposed to amalgamate the Canadian Air Brake Works at Hamilton, with that of the new Canadian Westinghouse Electric Company. It is not yet decided whether the new company will settle at Hamilton or elsewhere. The formation of a new company, is, however, absolutely certain."

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It is estimated that not less than 20 per cent. of the oil used on a bearing or journal, as a lubricator, is destroyed by friction. More than 80 per cent. is therefore wasted unless caught and filtered. Competition in all lines of business is now so keen that progressive managers are turning their attention to the stopping of leakages. Hence the importance of using oil filters. We draw attention to the advertisement appearing in this issue of what the manfacturers claim to be the only perfect automatic oil filter and extractor known,

The Dominion oil filter and extractor depends entirely upon natural laws for the performance of its work. No charcoal or other solid filtering material is used. It is automatic and requires little or no attention.

Heretofore it has been thought beyond the bounds of possibility to recover and purify the cylinder oil which escapes with the the exhaust steam. At least 85 per cent. can be saved and made commercially pure. The Guelph Foundry Company, Guelph, Ont., offer a free trial of this filter to all those who write to them, mentioning this Journal.

The Bell Telephone Company intend building a new exchange at Kingston, Ont.

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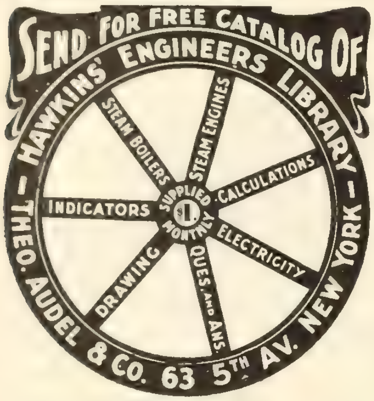

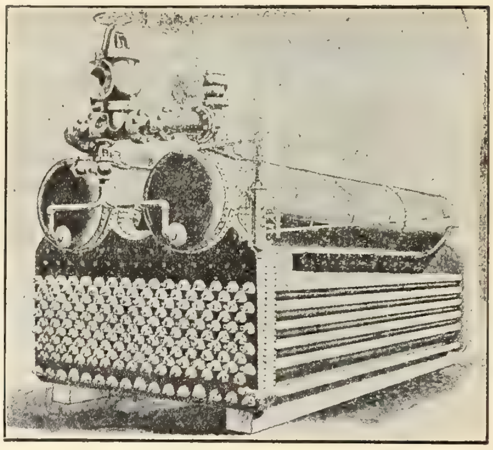

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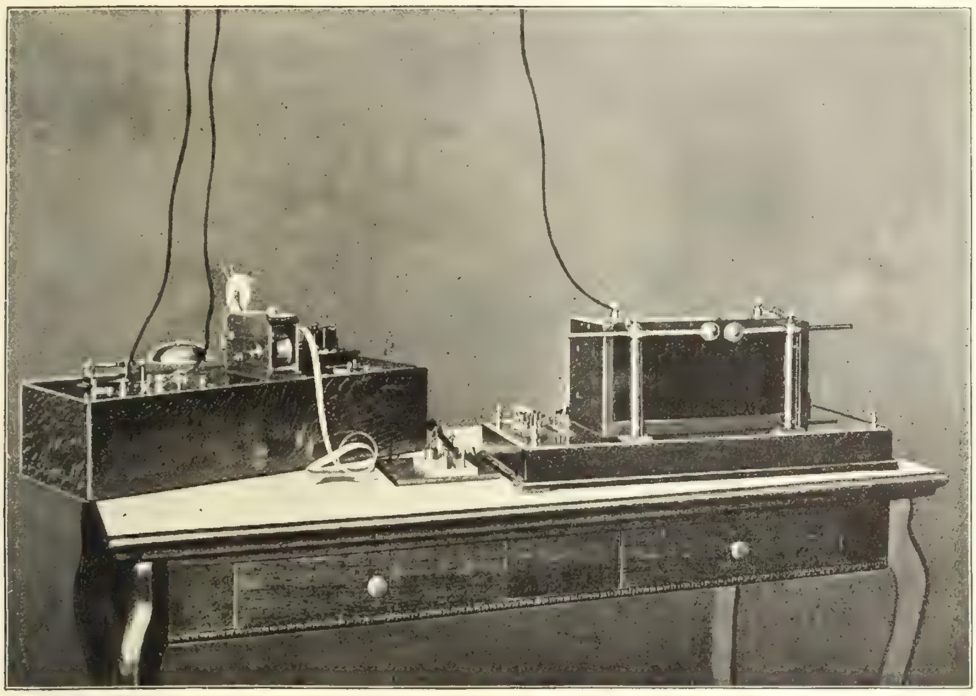

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SPARKS.

The Gananoque Electric Light Company, of Gananoque, Ont., have been busy recently putting the new Adams-Bagnall arc lamps on the arc circuit. The change is a most gratifying one indeed, the new lamps being of the latest and best design, and the town can now congratulate themselves on having the best street lamps made, the light from which is one hundred per cent. better than the old ones. In all, some twenty-one arc lights are on the streets, and if say ten more were added that would be one of the best lighted towns in Canada.

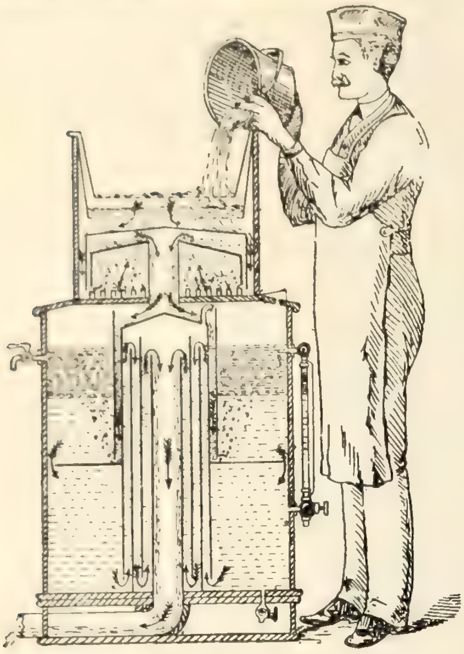

PLATE 2, Sectional View of Filter.

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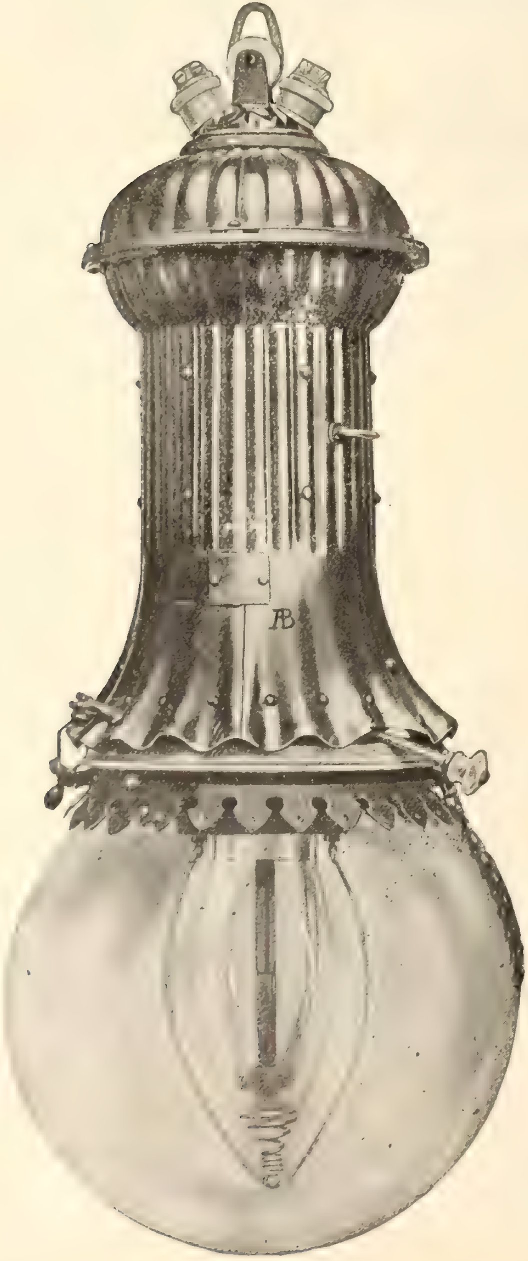

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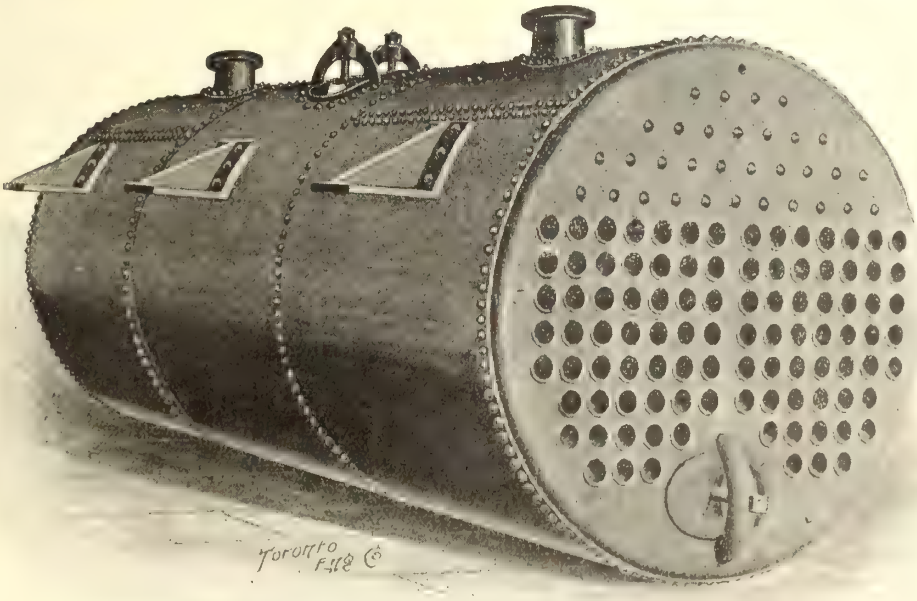

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July 8th, 1903.

Mr. W. G. Ross, Secretary–Treasurer of the Montreal Street Railway, will shortly occupy his new residence, No. 281 University Street, which he has lately purchased. The building is being practically rebuilt, and of course, re-wired for lights and bells. The architect is Mr. H. C. Stone, who will also have charge of the construction of the new Bank of Ottawa building.

The M. A. A. A. are putting up a handsome new club house and gymnasium. Mr. David R. Brown is the architect and his specifications call for the electric light wiring to be in iron conduit.

Fears were expressed that the numerous bush fires in the vicinity might damage the pole line which transmits current for 60 miles from Shawinigan to the Montreal Light, Heat & Power Company here for distribution. The line voltage is 55000, and the conductors " stranded aluminum."

The Montreal Terminal Electric Railway, which heretofore has only operated a line from the extreme east end of the city, viz : Maissoneuve to the end of the Island of Montreal (Bout de l'Isle) has now secured an entrance to the city proper and is at this date running its cars right in over its own tracks. No interchange of transfers has as yet been arranged with the Montreal Street Railway.

The new Chambly dam is soon expected to be repaired sufficiently to allow of current being turned on again. The broken dam has been costly business, as shown by the annual report. Mr. Pearson, engineer-in-charge, is at present on the spot at Chambly hastening completion.

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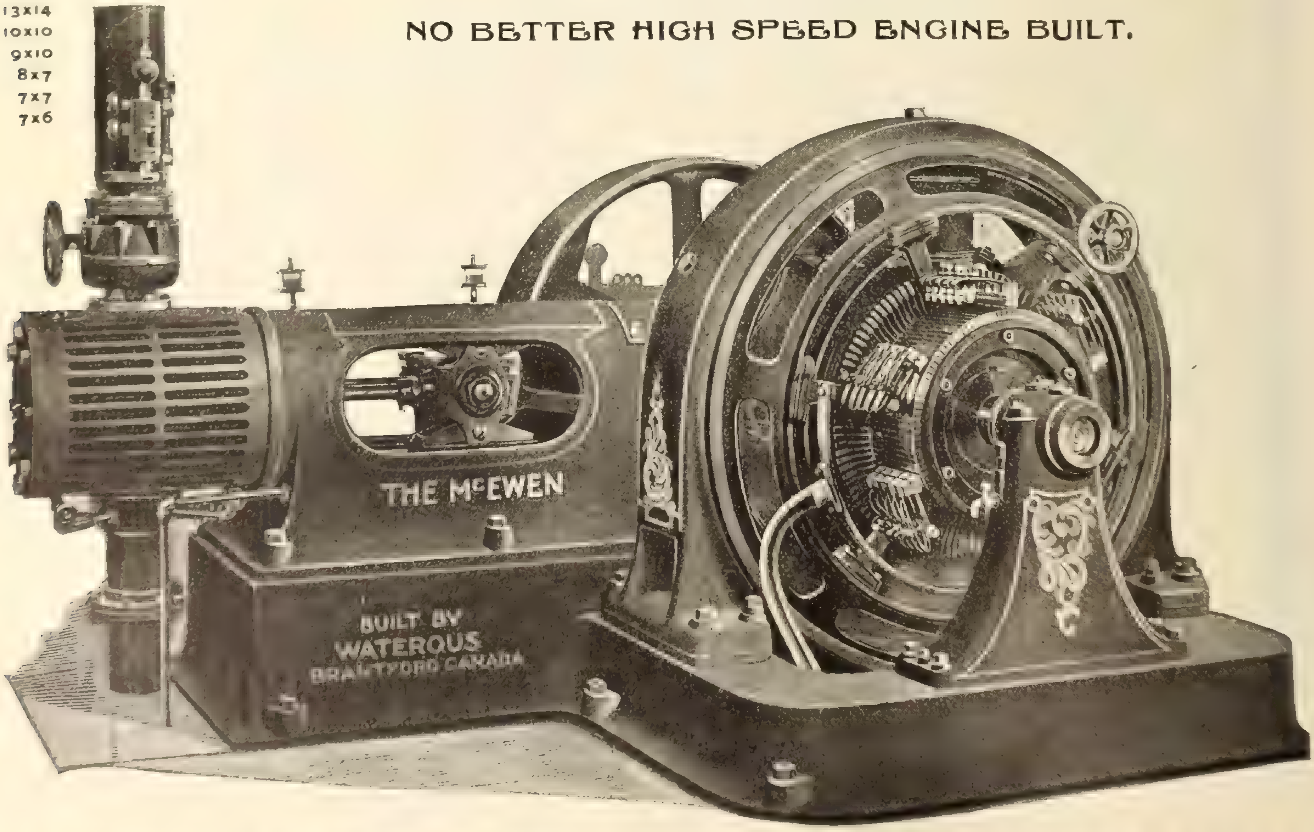

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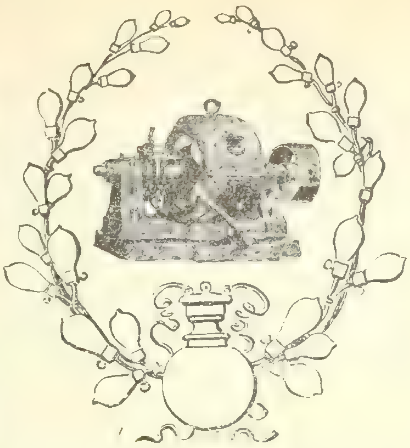

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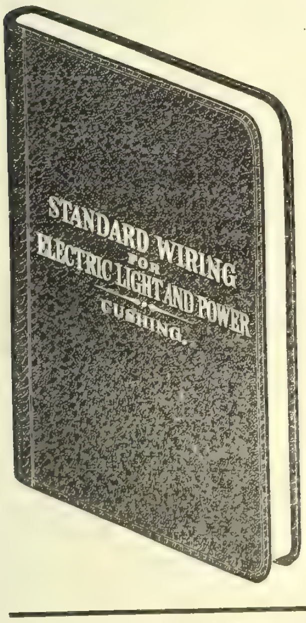

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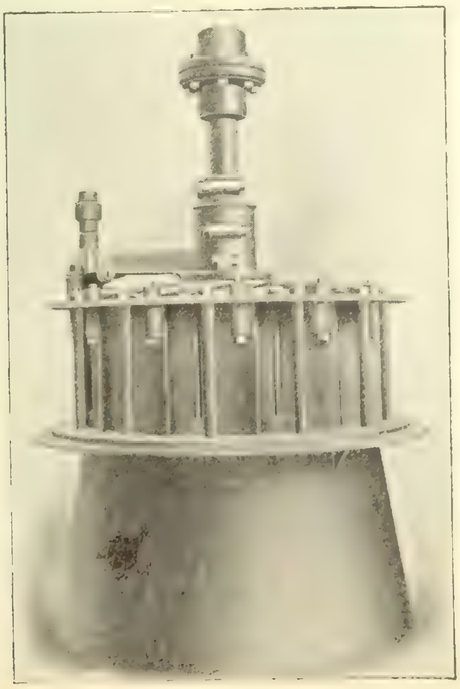

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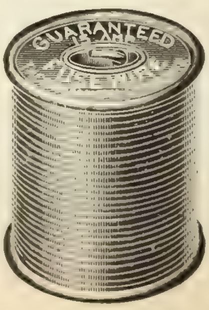

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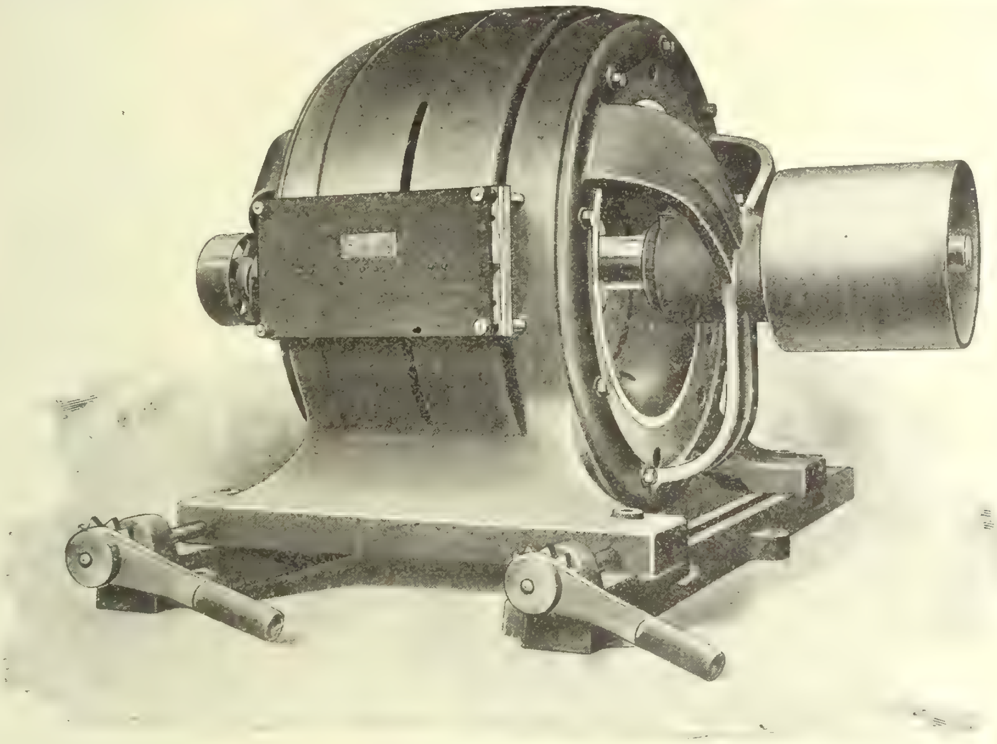

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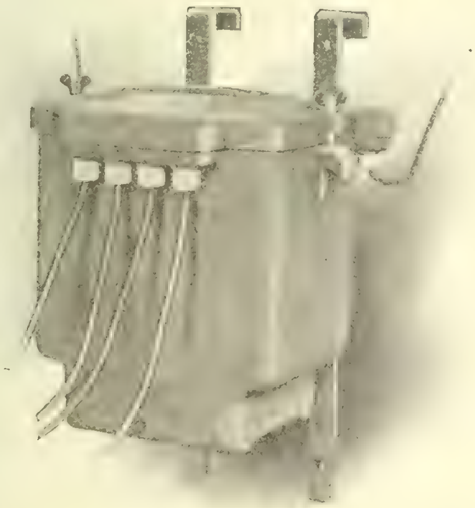

Front View.

OIL INSULATION

Rear View.

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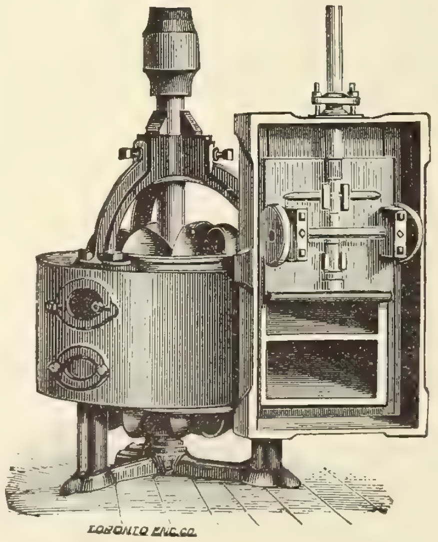
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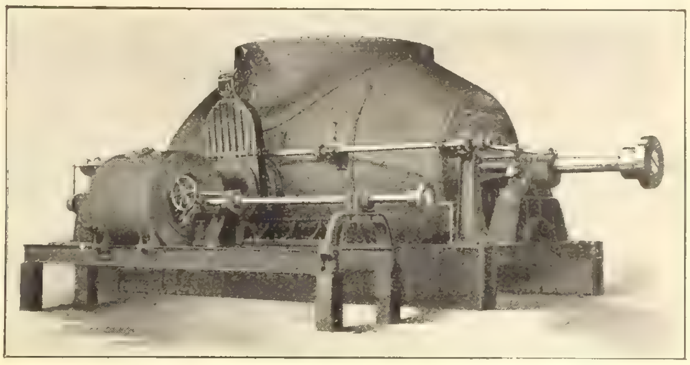

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SPARKS.

Mr. W. T. Wood is offering for sale the electric light plant at Millbrook, Ont.

New boilers have been installed by the Comfort Soap Company, Toronto Junction.

The Humber Power & Light Company, of Toronto Junction, Ont., are about to build a stone power house.

The ratepayers of Port Arthur, Ont., have voted in favor of extending the electric street railway to Current River.

The village council of Iroquois, Ont., are making arrangements to develop a water power for electrical purposes.

The Vancouver Power Company have commenced the erection of their transmission line within the limits of Vancouver, B.C.

Mr. John Galt, C. E., of Toronto, has prepared plans for a system of electric lighting, waterworks and sewerage for the city of Regina, N. W. T.

A syndicate has been formed to build a number of hotels in Cape Breton. The scheme includes the building of an electric railway from Mira to Sydney.

The electric light plant in the saw mill of the Harrison River Mills, Timber & Trading Company, Harrison River, B. C., was destroyed by fire last month.

The electric plant of the Skagway Light & Power Manufacturing Company has been purchased by the British Columbia Power & Manufacturing Company, of Atlin.

The Pictou Gas Light Company, of Pictou, N. S., have offered to sell their electric light plant to the town for $8,000. The question will be submitted to a vote of the ratepayers.

Thomas Luke, an employee of the Montreal Light, Heat & Power Company, has, according to report, been informed that he has been left the sum of $60,000 by a relative in Scotland.

The Ottawa Electric Company will light the civic buildings in Ottawa by electricity, their tender being $875 per year for a five year contract. The Consumers Electric Company tendered at $980.

The city council of Peterborough, Ont., have granted a franchise for an electric railway to the Peterborough and Ashburnham Radial Electric Railway Company, which is practically the American Cereal Company. The franchise provides that five miles of rail- way within the town are to be in operation not later than July 1, 1904. The plans of the company include extensions to Ashburnham, Lakefield, Young's Point and Chemong.

MOONLIGHT SCHEDULE FOR SEPTEMBER.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Sept. 2	0 10	Sept. 2	4 30	4 20
3	1 00	3	4 30	3 30
4	1 45	4	4 30	2 45
5	2 30	5	4 30	2 00
6	No Light	6	No Light	.....
7	"	7	"	.....
8	6 50	8	8 50	2 00
9	6 50	9	9 15	2 25
10	6 50	10	9 50	3 00
11	6 40	11	10 30	3 50
12	6 40	12	11 10	4 30
13	6 40	13	0 00	5 20
14	6 40	14	0 50	6 10
15	6 40	16	1 50	7 10
16	6 40	17	3 00	8 20
17	6 40	18	4 00	9 20
18	6 30	19	5 00	10 30
19	6 30	20	5 00	10 30
20	6 30	21	5 00	10 30
21	6 30	22	5 00	10 30
22	6 30	23	5 00	10 30
23	6 20	24	5 00	10 40
24	6 20	25	5 00	10 40
25	6 20	26	5 00	10 40
26	6 20	27	5 15	10 55
27	6 20	28	5 15	10 55
28	6 15	29	5 15	11 00
29	10 45	30	5 15	6 30
30	11 40	Oct. 1	5 15	5 35
		Total............		194 05

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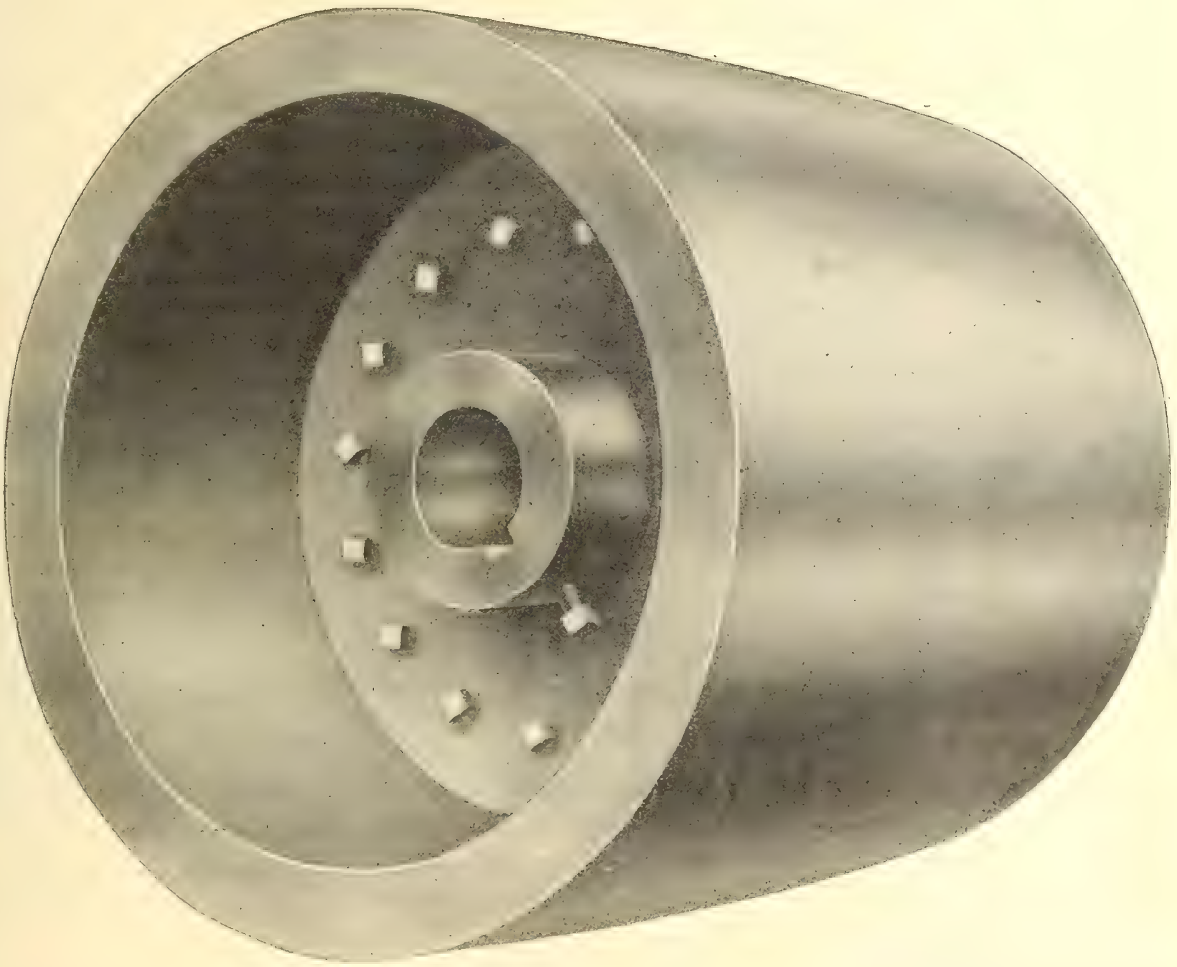

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TRANSMISSION LOSSES.

Various investigations secure varying results, from them we can strike an average for our own purposes. Henry Souther claims losses vary from 5 to 90% of the power generated before it reaches the consuming machinery. Undue friction in line shafting is a more serious matter than is generally supposed. Besides making heavy drafts on the coal pile, it is a source of loss in other respects. Mr. C. H. Benjamin, Professor of Mechanical Engineering at the Case Institute of Applied Science, at Cleveland, Ohio, states that in sixteen tests made under his direction, at manufacturing establishments of various kinds, he has found the amount of power to drive the shafting and belts to be from 14½ per cent. to 81 per cent. of the total load on the engine. Note well the amount—81 per cent. Referring to the 14½ per cent. factor, where the power loss was far less than in any other case tested, the professor says: As the machinery is of the automatic type, very compactly arranged, the conditions are about the same as in several other factories visited; but an inspection of the shafting shows that great care has been execised in its construction and operation. It is in perfect alignment, runs in cast-iron boxes without babbitt metal, and supported by unusually rigid hangers, while it is oiled by hand, instead of by wick oilers."

He advocates: (1) Use pulleys of larger diameter on counter shafts and narrow, fast running belts. (2) Use the best oil for the purpose, and enough of it, catching the drip and purifying it for repeated use. (3) Have everything oiled regularly, and do not depend too much on even the best of oiling devices. (4) Inspect line shafts to see if in line and will turn easily.

Neglected shafting, both in respect to alignment and lubrication, is the cause of tremendous friction. Anything that will do away with both of these evils at once deserves earnest consideration. A good so-called "frictionless" bearing will do this, as lubrication is practically unnecessary, and heavy pressures produced by lack of alignment count but little. Samuel Webber sub-divides the friction in a mill as follows: To run loose pulleys and their belts, 10 per cent.; to run main shafting, 20 per cent.;—the engine itself takes but 6 per cent. He puts overtight belting and consequent bending of shafting with resulting heavy journal friction as the chief cause of transmission losses. The average manager does not look at it in this light. Even this souce of friction may be avoided. If managers of factories would only take the pains to measure their idle load once in a while, they would find the information gained both instructive and surprising. Comparatively few do it. Some noon hour, or some evening at six o'clock, turn off all work on all machines and see what your engine indicates; it is something any of your engineers can do if furnished with an indicator, and I am sure you will feel repaid. Nine times out of ten you will overhaul a considerable number of things.—Power and Lighting Economist.

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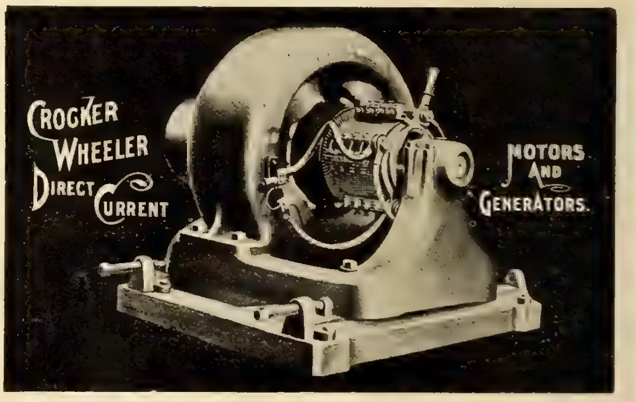

The Pretty Girl calendars are distributed every month. If you don't get these regularly send us your name for our mailing list. At the same time you might as well state when you will need more transformers. Then when you do order, think of Pittsburgh and send your order to us.

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The R. E. T. Pringle Company, Limited,
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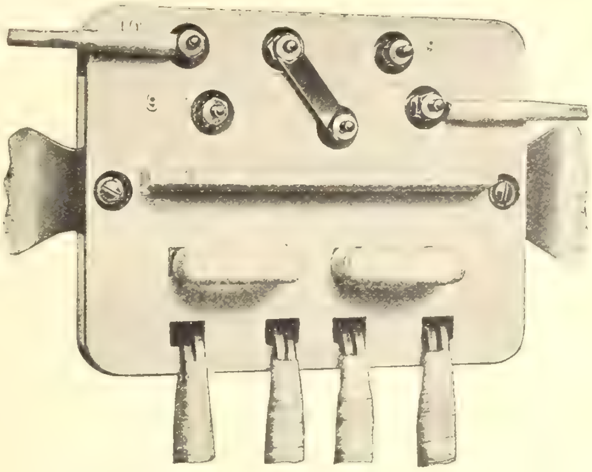
Type N and O D Transformers

This Terminal Block shows 2100 to 105-210 volt connection, one of nine transformer ratios secured by simple combinations. The table gives the others. . . . .



CLASS 200 TRANSFORMER		CLASS 400 TRANSFORMER	
Primary	Secondary	Primary	Secondary
1050	52½, 105,210	1050	105,210,420
	58, 116,232		116,232,464
2100	52½, 105,210	2100	105,210,420
	55, 110,220		110,220,440
	58, 116,232		116,232,464

No Central Station can afford to purchase transformers for two secondary voltages, when a choice of nine may be had from a type N or O D Westinghouse Transformer. . . . . . .

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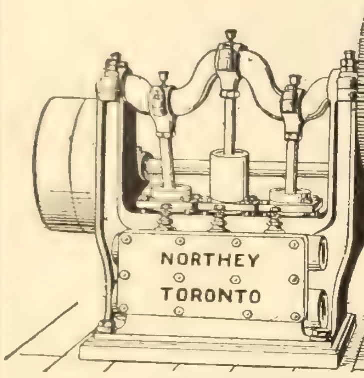

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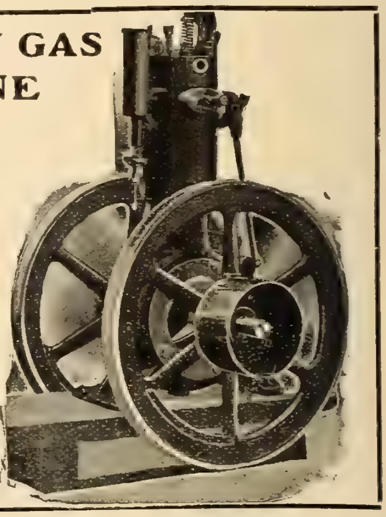

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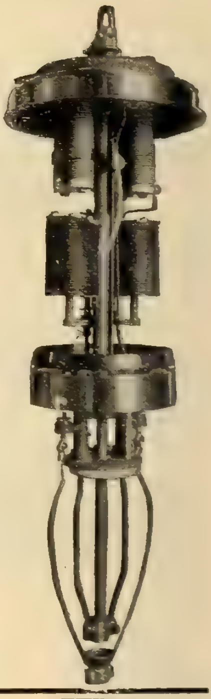

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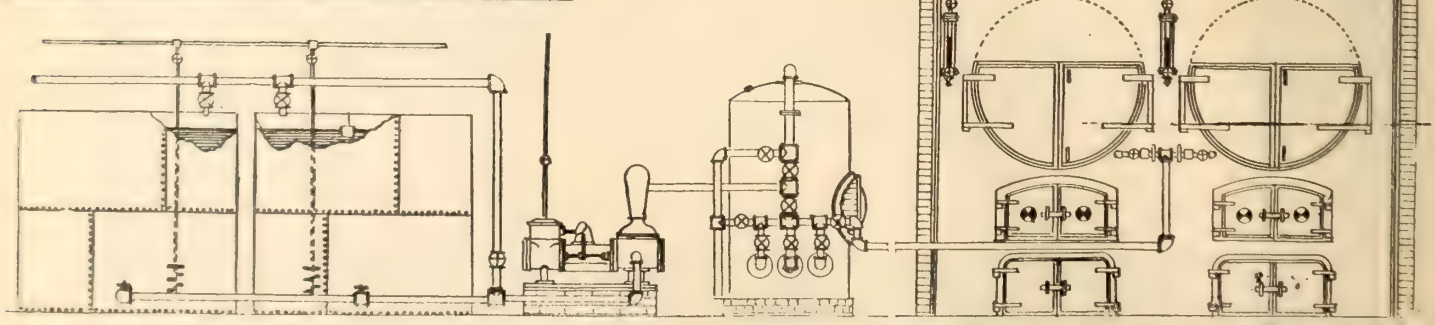

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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. AUGUST, 1903 No. 8.

VANCOUVER TRANSMISSION PLANT.

By Wyatt H. Allen.

In the early summer of 1902 work was commenced on the hydro-electric transmission plant of the Vancouver Power Company, Limited, near Vancouver, B. C., and while the completion of the undertaking is yet a matter of a year or more, there are many items of interest connected with the construction in progress and the plans for the completed equipment.

The installation of the plant is for the purpose of furnishing light and power for operating the street and interurban railways in Vancouver, New Westminster and Burnaby, and will ultimately have a capacity of 24,000 h.p., for which the hydraulic end of the plant is being developed. The initial installation of machinery will have a capacity of 6,000 h. p.

The sources of water supply for power are two very deep glacial lakes, known as Coquitlam and Trout, or Lake Beautiful. Their situation with respect to one another and to Vancouver is shown on the accompanying map. The first mentioned lake has an area of 2,300 acres, and is at an elevation of 32 ft. above the latter, which has an area of 460 acres. Both lakes are surrounded to their outlets by rugged mountains, rising abruptly from the shore lines, and between the two towers a granite range, 4,000 ft. above the water.

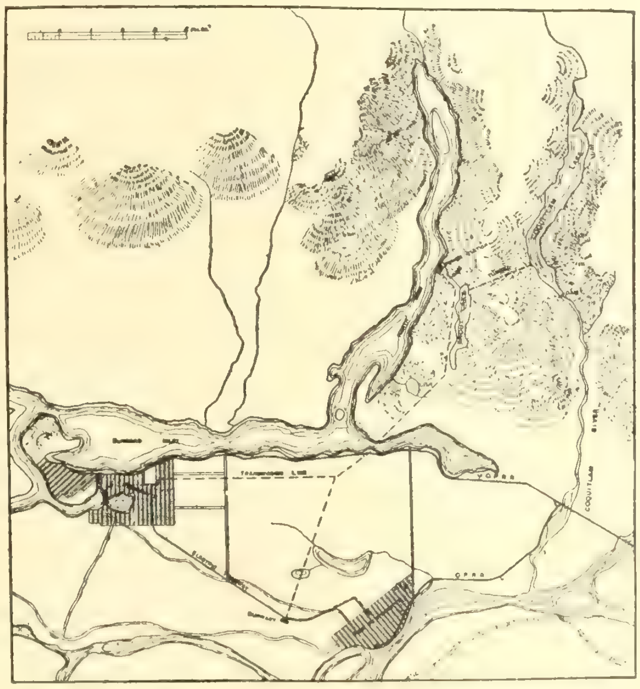


Fig. 1.—Map of Proposed Development.

It is through this range that a tunnel, 13,000 ft., or nearly 2½ miles in length, is being driven to connect the two lakes for the purpose of using the stored waters of Coquitlam for the main supply and Trout Lake as a balancing reservoir.

Both lakes will be controlled by dams at their outlets and from the dam at Trout Lake steel pipe lines will convey the water under an effective head of 390 ft. to the power station, located just above high tide mark on the shore of the North Arm of Burrard Inlet, into which the water wheels will discharge.

The dam at the outlet of Coquitlam Lake will raise the water 12 ft. above low water level. It will be constructed of rock-filled timber crib, a type which has proven thoroughly successful in many mountain streams. The materials are provided by nature in ample quantity at the point where they will be used. The dam will be planked and constructed with an apron, extending far enough down stream to prevent any back cutting action by the water flowing over.

The tunnel is 9 ft. wide by 9 ft. in height, with rounded corners, and is being driven from both ends by compressed air drills. At the portals open cuts were carried into the solid rock, and at one end, where the depth of the open cut became inconvenient, a tunnel was driven for a short distance, temporarily timbered, and the ground above the roof of the tunnel stoped down through chutes in the roof directly into the car. Before the machine drills and air compressors arrived, hand drills were used, and the average progress was two feet per day in each heading, but since the advent of the drilling machinery this has been increased to 10 ft. per day. A system of electric haulage has been installed to facilitate the rapid and economical removal of the muck. The plant at each end includes a 100 h. p. boiler, 60 k. w., 500-volt generator and a four-drill, two-stage air compressor.

Ventilation is provided for by a 12-in. galvanized iron pipe, through which the air is exhausted by means of an air jet under 100 lbs. pressure, acting as an ejector. This is only put in operation for a few minutes after each blast to remove the smoke, the exhaust from the air drills furnishing all the fresh air necessary at other times. A concrete dam 350 ft. long on the crest and 50 ft. high is now in course of construction across the outlet from Trout Lake, and arrangements have been made for bringing ten 54-in. pipe lines from the dam, but only three lines will be completed at the present time. Each steel pipe line will be 1,600 ft. in length, 48 in. in diameter at the upper end, 44 in. in the middle section, and 42 in. at the power station. Close to the power station site on the shore of the North Arm, a wharf has been erected, at which steamers and barges from Vancouver may discharge their freight on to the cars of an incline tramway, built from the wharf to the tunnel portal at Trout Lake.

By this means all material for the camp at the tunnel portal and for the dam and pipe lines is delivered rapidly and with the least possible handling.

To deliver material to the tunnel camp at the Coquitlam portal is quite a different undertaking, since it can only be reached by wagon road from a station on the Canadian Pacific Railway, ten miles distant. For the greater part of the distance the road penetrates the dense forests, and in winter can be kept in a passable condition only by constant attention.

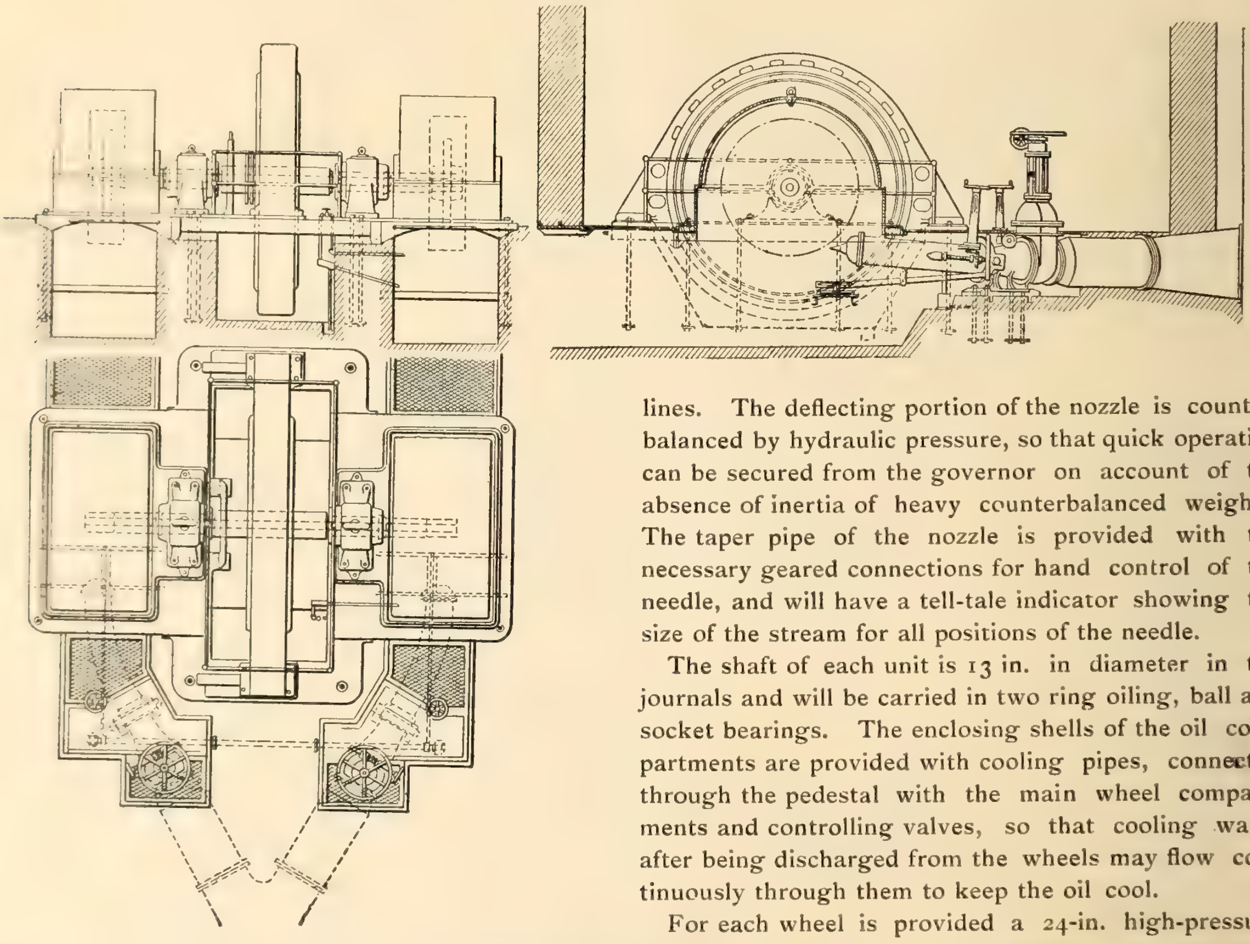


Fig. 2—Elevations and Plan of Water Wheels and Generators.

The power station will be constructed of granite masonry and much of the material excavated to obtain a building flat will be used in the walls.

The water wheel equipment will consist of three sets of impulse wheels, made by the Pelton Water Wheel Company, each set capable of developing a maximum of 3,000 h. p. at 200 r. p. m., under the effective head of 390 ft., and one set consisting of 200 h. p. wheels for driving the exciters at 580 r. p. m. Each of the main units will consist of two overhung wheels, one mounted on each end of the shaft of a 1,500 k. w. Westinghouse engine type rotating-field generator. The wheel centers are of the steel disc type, and fitted with cast-steel buckets, secured to the wheel rim by turned steel bolts driven in reamed holes. The hubs of the wheel centers are bored out for a press fit on a shaft 12 in. in diameter, and will be pressed on in place at the power station. Each wheel will be enclosed in a cast-iron housing, and provided with centrifugal discs and pockets, and suitable drain pipes for preventing leakage of water along the shaft.

Probably the most interesting feature of the equipment is the single combination, deflecting and needle regulating nozzle provided for each water wheel, and fitted with a high-pressure ball joint, which is leather-packed, and rocks on forged steel trunnion bolts. The joint permits of effecting regulation by deflecting the nozzle by governor or hand, independent of the control of the needle, thus permitting of load and speed variations, independent of any change of velocity in the pipe lines. The deflecting portion of the nozzle is counterbalanced by hydraulic pressure, so that quick operation can be secured from the governor on account of the absence of inertia of heavy counterbalanced weights. The taper pipe of the nozzle is provided with the necessary geared connections for hand control of the needle, and will have a tell-tale indicator showing the size of the stream for all positions of the needle.

The shaft of each unit is 13 in. in diameter in the journals and will be carried in two ring oiling, ball and socket bearings. The enclosing shells of the oil compartments are provided with cooling pipes, connected through the pedestal with the main wheel compartments and controlling valves, so that cooling water after being discharged from the wheels may flow continuously through them to keep the oil cool.

For each wheel is provided a 24-in. high-pressure gate valve, with roller bearing thrusts. The gates are all furnished with the usual hand wheel, and in addition there is provided a worm gear device, which can be connected at will to facilitate the working of the gate when nearly closed.

The governing of the water wheel units will be effected by means of three Lombard governors. The type adopted operates under water pressure, and the water used by them will be first passed through a filter tank, located some 200 ft. above the power house.

The two 80 k. w. exciters with their respective wheels will be mounted on a common bed plate, with a 120 h. p. induction motor between the two exciters. Each exciter will be provided with a pair of jaw clutch couplings and shifter rigging, so that either water wheel will drive its exciter and the induction motor at the same time. The motor leads are connected to the main bus-bars, and the motor is normally run at synchronous speed, neither giving nor taking electric power. Should the exciter water wheel nozzle become clogged and the speed fall, the motor immediately takes power from the bus-bars and drives the exciter until the nozzle is cleared by the attendant, or the other exciter unit started up. The deflecting nozzles of the exciters are arranged for hand regulation from the exterior of the wheel case through worm gearing.

The contract for the entire electrical equipment has been awarded to the Westinghouse Electric & Manufacturing Company, and includes the apparatus for the generating station and the sub-stations at Vancouver and Burnaby.

The three 1,500 k. w., 60-cycle, 2,200 volt alternators for the power station are of the rotating field type, and arranged for a movement of the external frame in a direction parallel to the shaft to allow access to the windings.

For the control of the apparatus at the power station the switchboard will contain nine panels, one for the induction motor and one for each exciter, three panels for control of the main units, and three for the control of the three sets of 550 k. w. air-cooled transformers, with their motor blower sets, consisting of 20 h. p motors and 110-in. Sturtevant fans.

The step-up transformers, static interrupters, high-potential switches and lightning arresters will be installed in a separate building located on the hill above and just back of the power house. As the static interrupters contain oil, they will be separated from the main room and each other by brick partitions.

The machinery for the sub-stations includes the usual transformers, rotary converters, switchboards, etc., for the reception and distribution of transmitted power.

The route of the transmission lines to Vancouver is 16 miles in length, and involves the crossing of a navigable arm of Burrard Inlet, with a span of 2,800 ft. On one side two steel towers 140 ft. in height will be erected to support twelve 9-16-in. galvanized plow steel cables with wire centers, but on the opposite side there is high ground and the cables will be supported on poles.

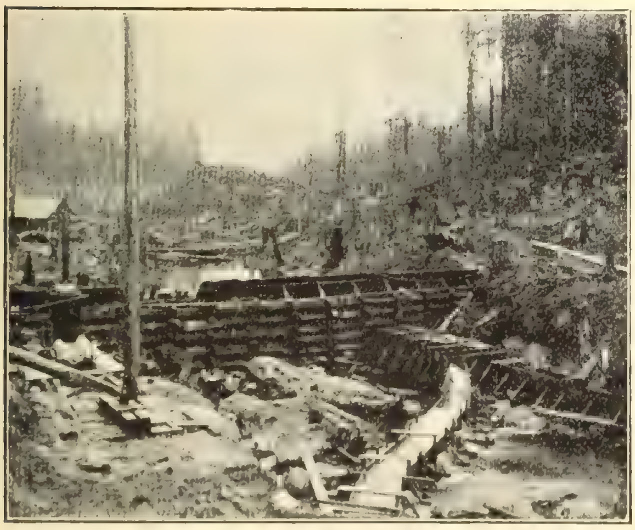


FIG. 3—TEMPORARY CRIB DAM.

Two independent transmission lines, each consisting of two 3-wire circuits of No. 2 copper, will be constructed on the same right of way, to a point near Barnet. From here one line will be continued to Vancouver and the other to Burnaby.

A transmission line already exists between Burnaby and Vancouver, which will be reconstructed to carry 20,000 volts, the pressure to be used on the new lines, and a new line will be built from Burnaby to New Westminster, thus providing what is in effect a double transmission line over the entire distance between the power station and each of the sub-stations.

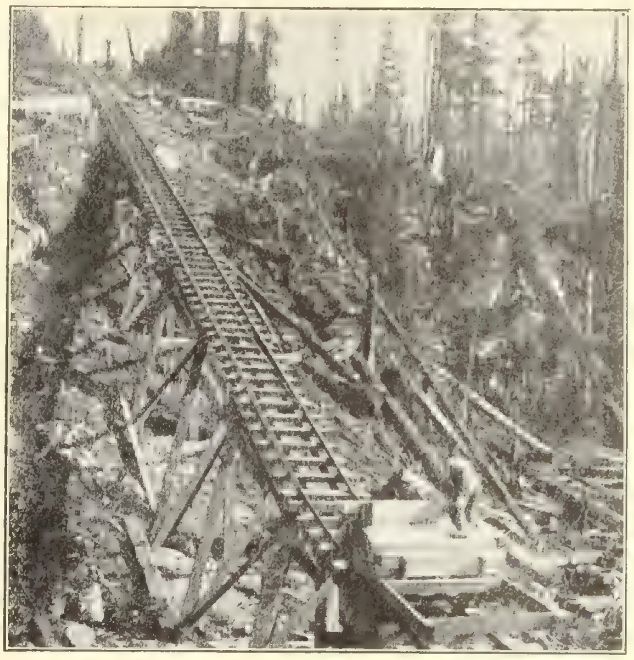


FIG. 4.—VIEW OF INCLINED TRAMWAY FROM WHARF.

Mr. Wynn Meredith, of the Engineering Offices, of San Francisco, is directing the entire work, assisted by Messrs. Hermon and Burwell, civil engineers, of Vancouver.—Electrical World and Engineer.

OIL AS A SCALE REMOVER.

One of the best, and most talked of and most abused methods of removing boiler scale, regardless of its thickness, is the introduction of coal oil. The proper quantity will depend upon how fast the scale comes off ; this varies in different localities. In some cases one pint in ten hours is about right, in others one-half pint and even one-fourth pint has been found sufficient. Very few boilers, no matter what size, require more than one pint in twenty-four hours, the oil to be fed into the feed pipe a drop at a time. This will be found sufficient for a boiler that will figure out 150 horsepower at twelve square feet per horsepower. Smaller boilers will usually require an amount in proportion to their size.

One mistake engineers frequently make when using kerosene oil is in using too much. Whether this is due to the recommendation of the parties selling the feeder, so as to prove their claims of efficiency by the rapid loosening of the scale, or to the desire for early results on the part of the engineer, is not for us to say, but it is a fact learned by experience that there are more men using too much oil than too little.

The Great Falls Power Company is the only one that has submitted a tender for the supply of electric energy for the city of Winnipeg, the price being $50 per annum per horse power.

The Sarnia Gas & Electric Light Company have arranged to obtain a supply of sawdust for fuel from the Cleveland-Sarnia Saw Mills Company. The sawdust will be conveyed from the mill to the boilers of the electric light company by automatic carriers.

ELECTRIC LIGHT AND WATERWORKS PLANT AT KAMLOOPS, B. C.

In the year 1894 the corporation of the City of Kamloops decided to install and operate their own waterworks and electric lighting plants. One year later the waterworks was completed and in the spring of the following year the electric light plant was put in operation.

The waterworks at that time consisted of two return tubular boilers, built by the William Hamilton Manufacturing Company, of Peterboro, Ont., and two duplex pumps, one being a Worthington with a capacity of 600 gallons per minute and the other a Northey underwriter's pump having a capacity of 900 gallons per minute against a head of 160 lbs. pressure per square inch.

The electric light plant consisted of one Robb-Armstrong, high speed, simple, automatic engine, cylinder diameter 13", stroke 12", running at 310 r.p.m., which was belted to a 60 k.w. United Electric Improvement Co. (Philadelphia, Pa.) alternator having a frequency of 125 cycles, 1000 volts, at 680 r.p.m.

The machinery was all installed in one building and continued to give satisfaction until 1900, when the rapidly increasing demand for both water and light rendered the extension of plant necessary. After receiving the advice of Mr. Willis Chipman, C. E., of Toronto, the City Council decided to abandon the old site and construct complete new works. This was done, and in the fall of 1902 the new works were taken over; the old pumps and electric plant being removed to the new building.

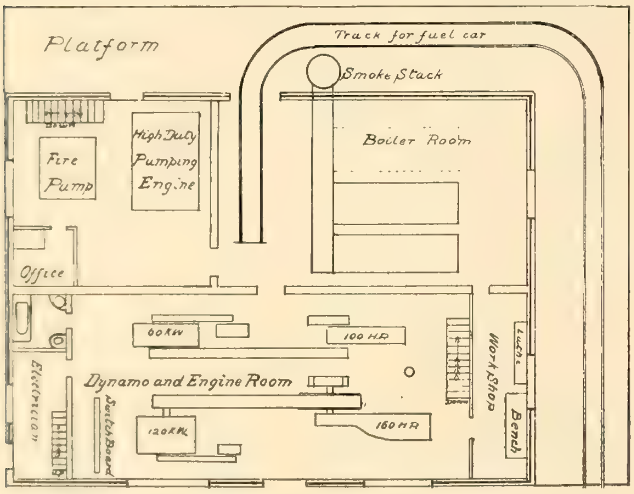


Fig. 1.—Floor Plan of Municipal Power House, Kamloops, B. C.

The power house (Fig. 2) is built of brick on granite and cement foundations, and has a frontage on Lorne Street of 80 feet, with a depth of 60 feet, the interior being divided on logtitudinal centre line by a brick fire wall extending the entire length, making on one side dynamo and engine room 60 ft. x 28 ft. 6 in., workshop 28 ft. 6 in. x 10 ft., office and lavatory, etc., 28 ft. 6 in. x 10 ft.; on the other side the space is again divided by a brick partition, making pump room 28 ft. 6 in. x 30 ft. and boiler room 28 ft. 6 in. x 47 ft.

The building is roofed with galvanized iron, with standing seams, laid on shiplap, the whole being carried by heavy timber trusses, by which the machinery can be hoisted for repairs, etc. The whole building is well designed and constructed, comfortable and convenient, and presents a very neat and attractive appearance.

The new electric light plant consists of a Robb-Armstrong, tandem compound, condensing, side crank engine, cylinders 12" and 20" in diameter by 16" stroke, running at 210 r.p.m., which is connected to a Northey jet condenser. It is giving splendid satisfaction, making an actual saving of 1300 lbs. of coal per 12 hours run over the high speed simple engine formerly used, and this when the engine is running under most disadvantageous conditions of light load, while the former engine was run under fairly good conditions, being for the greater part of the time well loaded. The saving will be more noticeable as the load is increased. This engine was manufactured and supplied by the Robb Engineering Company, of Amherst, N. S. It is belted to a Canadian General Electric standard 120 k.w. composite wound single phase alternator having a frequency of 125 cycles, 1000 volts, at a speed of 1070 r.p.m., and gives very close regulation.

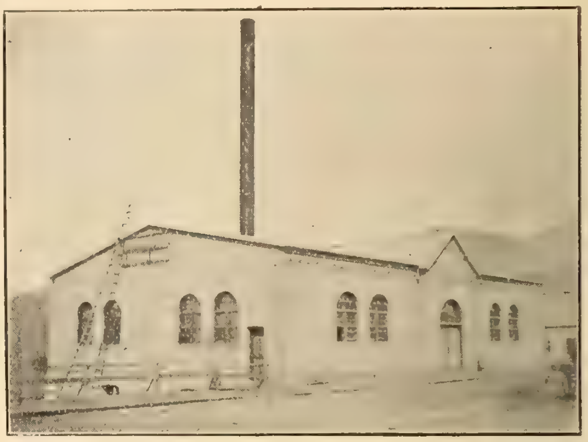


Fig. 2.—Power House.

The switchboard (Fig. 4) is of blue Vermont marble, finely polished, and fitted with quick break switches, detachable fuse blocks, and Weston instruments in black oxide finish, the whole presenting a very handsome appearance. The lightning arresters, rheostats, transformers, etc., are mounted on the back of the board. The old board is temporarily set on one side. At the present time there are about 3,000 16 c. p. lamps wired on the circuits, not including the street lights, but as current is supplied to the consumers by meter, the average load does not reach the capacity of the plant.

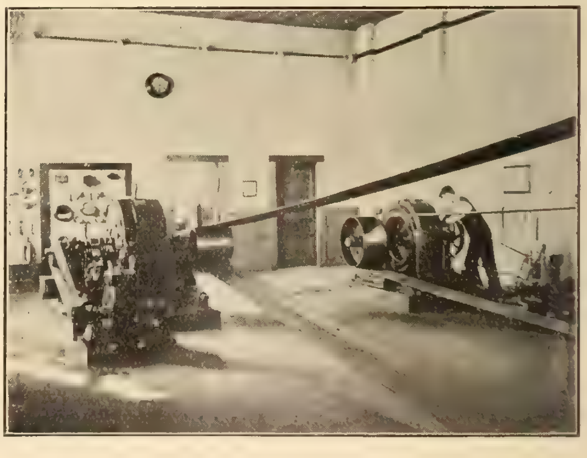


Fig. 3.—Generators.

The streets are lighted with series incandescent lamps, mounted on neat goose neck brackets (supplied by Munderloh & Co., Montreal), placed at a height of 16 feet from the ground, and visitors say Kamloops streets are very well lighted. The lamps are placed 250 feet apart and are wired on two circuits of 26 in series, 6 amperes across the primaries. There is also another circuit of 14 32 c. p. lamps in series, and in the outlying districts several 16 c. p. lamps are temporarily connected to the commercial secondaries. The old plant is installed on the other side of the engine room and forms a duplicate or reserve.

This department is under the charge of City Electrician Fred J. Marshall, who has been in the employ of the city in that capacity for nearly eight years. T. A. Shackleton is second engineer.

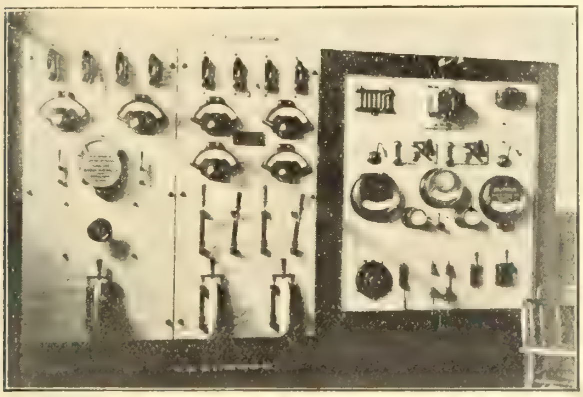


Fig. 4.—Switchboard in Power House.

The waterworks, which is under the control of C. L. Wain, who has been with the city for seven yaars, has also a reserve plant. The new high duty pumping engine (Fig. 5) was manufactured and supplied by the Smart Turner Machine Company, of Hamilton, Ont., and is a vertical cross-compound condensing Corliss pumping engine, the first of this type to be manufactured in Canada, and has a capacity of 1000 imperial gallons per minute against a head of 140 lbs. pressure per square inch. The pumps are placed immediately below the engine in the well, the concrete walls of which serve as foundations. The pumps are placed as near the water as practicable on account of the great difference between high and low water levels on the South Thompson river, from which the water is taken, about 600 feet distant from the power house.

The water flows into the well through a syphon 12″ in diameter, there being a rise in level between the river and the well of 2 feet ; after entering the well it has a drop of 18 feet to the bottom of well, giving at extreme low water a working head of nearly 6 feet ; this was done to avoid expensive ditching across the flat. This syphon was designed by Mr. Willis Chipman and is giving good satisfaction.

The pumping engine is run surface condensing, the discharge water from the pump being delivered through the condenser to the main, thus providing ample cooling medium without cost. This, of course, adds greatly to the efficiency. The condenser, air pump, hot well and boiler feed pump are placed in the basement in close proximity to the engine. The contract for this engine is not yet completed, as the manufacturers desire to make another test to reach the guaranteed duty of one hundred and fifteen million foot pounds, which was very nearly attained on the previous trial.

The water is delivered by the pump into the mains and thence to the reservoir, the mains being connected at the intersecting streets by special crosses, tees, and gate valves, thus giving complete control of the supply to any part of the town. The reservoir is on the hill immediately south of the town at an elevation of 280 feet, and gives a static pressure on the mains of 125 lbs. per square inch. It is excavated in the ground, the soil being a conglomeration of "hard pan" and gravel. The excavating was extremely difficult on account of the nature of the soil, digging being impossible, and the material could only be removed by blasting.

The sides of the reservoir are built of Portland cement concrete sloping to the top, 48 inches thick at the bottom and 24 inches at top. The floor or bottom of reservoir is dished and about 18 inches thick. This all received a coating of 1 inch of cement plaster, and was then repeatedly washed with cement wash to render it impervious. The capacity of the reservoir is 150,000 imperial gallons. It is covered with a strong shingled cottage roof and has a very attractive appearance.

The boilers were also manufactured by the Robb Engineering Company and are the "Mumford standard boiler", a tpye which possesses a great many important points in their favor, and which so far have have fully carried out the claims made for them by the manufacturers. They each have a guaranteed evaportation of 5,250 lbs. of water per hour from and at an initial temperature of 212° Fahrenheit, and have a working pressure of 125 lbs. per square inch. They are self contained, having no brick setting, being cased in a sheet steel case covered with 2 inches of asbestos plaster to prevent radiation.

The smoke stack was supplied with the boilers and is constructed of steel plates. It is 88 feet high and 45 inches in diameter, the first 40 feet being of ¼ inch plate and the remainder 3/16 plate. It is erected outside the building on a solid granite and cement foundation 12 feet high, making the total height from ground level to top of the stack 100 feet.

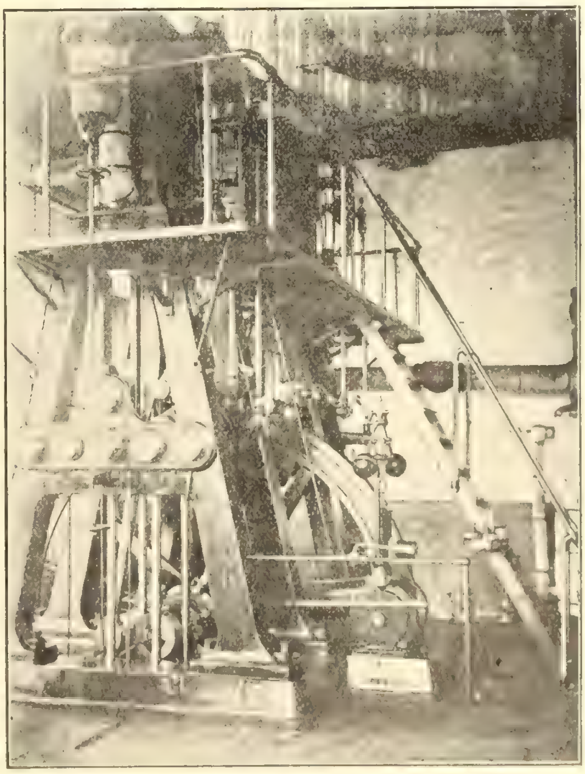


Fig. 5. Waterworks Pumping Engine.

The cost of the new building and plant, reservoir, mains, etc., was $50,000. The increased economy of operating the new plant compared with the old has resulted in a reduction of 5% on both water and light rates to the consumer.

THE LATE MR. F. H. BADGER.

The electrical fraternity learned of the death of Mr. F. H. Badger, superintendent of the Montreal Fire Alarm System, with deep regret. Deceased was taken ill some four months ago. It was thought a sojourn at Portland would lead to his complete recovery. For a time his health grew better, but the change was only temporary and finally death came on July 29th. He was one of the oldest employees in the civic service and was much respected for his sterling qualities.

THE LATE MR. F. H. BADGER.

Franklin Hodgkins Badger was born at Salem, U. S., 68 years ago. He attended the high school in Boston for some years, but was practically a self-made man. While young he entered the service of the fire alarm office at Boston, where he exhibited uncommon skill and intelligence. He remained there until 1862, and one year later was requested to organize a fire alarm system for the city of Montreal, of which he was appointed superintendent.

Mr. Badger was deeply interested in electrical matters and it was his good fortune to enjoy the acquaintance and friendship of many leaders in that science. He spent considerable time and money in research and invention, and, with the aid of Mr. J. Plewes, invented a device to prevent high tension foreign current from entering on interior wiring.

Mr. Badger from his youth was a student of the facts and philosophy of evolution. In other departments of science he was well versed and widely read. His conversational powers were remarkable; as a generous, whole-souled and upright man he made a host of friends. A widow and one daughter, Mrs. Alderman Turner, of Portland, Maine, survive.

PERSONAL.

Mr. Albert Dupuis, electrical engineer, Montreal, is at present on a business trip through England, France, Germany and Switzerland.

Mr. James Ross has resigned from the vice-presidency of the Toronto Street Railway Company. It is understood that he is desirous of giving closer attention to the affairs of the Dominion Coal Company and the Dominion Iron & Steel Company.

Mr. A. W. Douglas has tendered his resignation as secretary of the Shawinigan Water & Power Company, of Montreal, and is about to leave for the Pacific coast. He will be succeeded by Mr. Howard Murray, who has been connected with the company for a number of years.

INCANDESCENT, NERNST AND OSMIUM LIGHTS.

A series of tests of these lamps has been made in Berlin and reported in Elec. Auzeiger. It shows:

Osmium: Gradual increase in energy and decrease in c. p. Loss in c. p. 25%. A twenty-five-candle-power, thirty-seven-volt lamp, 1.65 average watts per candle; depreciation, $1.25 for 300 hours; average cost per candle-hour, 0.043 cent.

Incandescent: The average consumption is given as 3.2 watts per candle. The depreciation charge for 300 hours is taken at 8.4 cents. With electrical energy at sixteen cents per kilowatt-hour, the average cost per candle-hour is found to be 0.05 cent.

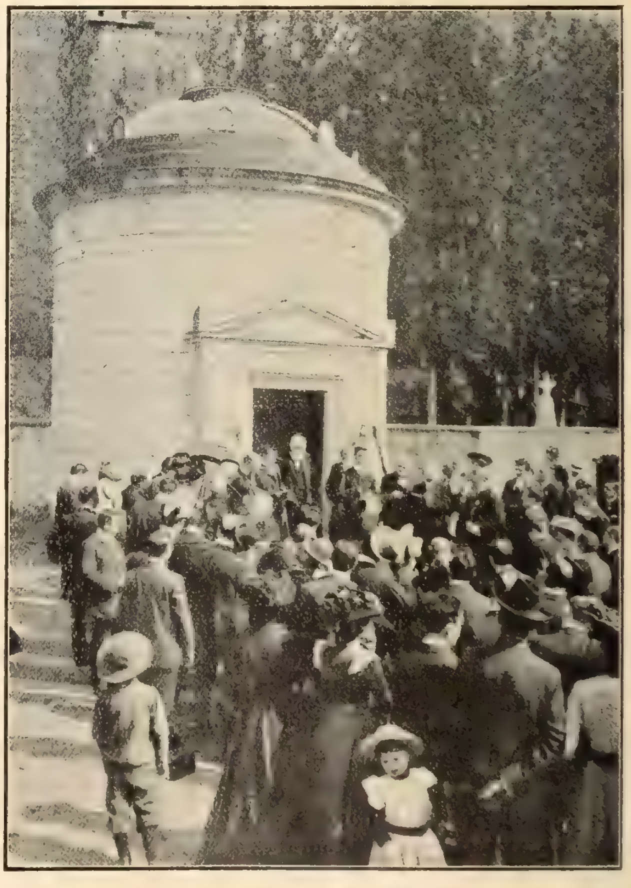
Nernst: A 130-candle-power, 220-volt Nernst lamp, 2.05 average watts per candle; depreciation charge for 300 hours, fifty cents, costing 0.035 cent per candle-hour.

HONORING A DEPARTED SCIENTIST.

The scene portrayed herewith, reproduced from Page's Magazine, represents the laying of a wreath on the tomb of Volta at Camnago, in the name of the British Institution of Electrical Engineers, on the occasion of an excursion to Italy, April 5th, 1903.

Professor Allessandro Volta (junior), who is the grandson of Volta, is seen standing between the President and Mr. John R. Hewett; the latter is presenting, on behalf of the students of the Institution of Electrical Engineers, a shield of bronze.

Allessandro Volta was born at Como, in 1745, and died there 1827. He was successively Professor of Physics at the Gymnasium in Como, and the University of Pavia, where he invented the electrophorus and the electroscope; he also devised several other electrical appliances, and in 1800 invented the Voltaic Pile, the far-reaching consequences of which were dealt with in Professor Thompson's speech, delivered at the tomb.



LAYING A WREATH ON THE TOMB OF VOLTA IN THE NAME OF THE BRITISH INSTITUTION OF ELECTRICAL ENGINEERS

QUESTIONS AND ANSWERS

"R. T.": As the Thomson recording wattmeter has been explained to me, it is simply a little motor driving a registering dial. Now, if this is the case why does it run faster as the load gets greater, instead of slowing down as an ordinary motor does. Also will you give me the short formula for testing these meters by?

Ans.—This instrument, as you say, consists of a motor driving a dial through a train of mechanism, the speed of the motor increasing with increasing load because, there being no iron in the armature or field, the former has practically no counter E.M.F., which means that the speed must be proportional to the strengths of the field and armature currents, that is, increasing with a rise in either the voltage of the circuit, which controls the armature current, or an increase in the current flowing in the circuit, which means a stronger field. The formula you refer to is as follows: $E\ C = 60\ G \times S$, in which E is the voltage, C the current, G the constant of the meter, and S the speed of the disc in revolutions per minute. The retarding magnets are moved in or out to increase or decrease the speed as required until the equation is satisfied. If you are working with alternating circuits E C must be muliplied by the power factor.

A Quebec reader asks: Is it necessary to separate the three conductors of a three phase line, when using lead cables in conduits? Does the lead cause any greater drop in the lines? What are the bells on the ends used for?

Ans.—There will be voltages generated in the three lead coverings which will cause currents to flow between them and which may injure the lead. They are usually separated by putting a braid or tape over the lead. The lead introduces some extra drop, which is ordinarily quite negligible. It can be entirely eliminated by using three conductor cables. The cable bells are for the purpose of taking care of the static discharge, which otherwise might puncture the insulation at the end of the cable. They also serve in the case of multiple conductors as a convenient means of separating the leads as they leave the cable proper.

"X Y Z": Please inform me through your paper of the proper formula for calculating h. p. on a 3-phase circuit when only one voltmeter and one ammeter are used, the load on all three legs presumably the same, being an induction motor with a few lights evenly distributed over all three legs.

Ans.: The horse power of a three-phase circuit, assuming equal loads in the three wires, and that the three voltages are also equal, is given by the formula

H. P. = amperes (in one wire) × volts × 1.732 × power factor ÷ 746.

The power factor for a load consisting entirely of lights is about .95; if it is all motors .75 to .85, depending on the size, style, point to which they are loaded, etc. For a combination of the two, the motor being the larger part of the total, we would think that a constant varying from .85 to .9 was about correct, assuming a 30 h. p. machine or larger, if it is smaller than that .8 to 85 might give more correct results. It should be noted that the above formula, owing to the power factor being estimated, does not give absolutely correct results, which can only be obtained by the use of a power factor meter in conjunction with an ammeter and voltmeter, or else a wattmeter, which latter instrument combines the three others in one case.

"Station Manager": We have an induction motor, three phase, which takes 28 amperes at 400 volts. What power is it giving out?

Ans.—Before your question can be answered definitely you would have to know the power factor and efficiency of the machine in question; assuming 80% and 85% respectively the output in horse power would be

$$\frac{28 \times 400 \times 1.733 \times .8 \times .85}{746} = 17.69 \text{ h.p.}$$

"Engineer": Would you be kind enough to tell me what is a direct acting engine, also what is the meaning of the term trunk engine?

Ans.—A direct acting engine is one in which the piston and connecting rods act directly on the shaft or other device which they actuate. This is the form of the large majority of the engines used to-day, the indirect acting engines being those that do their work through the medium of an intermediate device such as the walking beam used in some types of marine and pumping engines. A trunk engine is one which has no piston rod, the connecting rod being coupled direct to the piston. It gets its name from the trunk or extension of the piston which it is necessary to provide to keep the latter in place. The oscillating piston engine, which has no connecting rod, is the opposite of this type.

"W. R.," Toronto: What is the difference between the auto-starter or compensator, used in place of a rheostat to start induction motors, and ordinary transformers? Why wouldn't transformers be satisfactory?

Ans.—The main difference is in the fact that there is but one winding on the auto-starter or compensator, which forms both the primary and the secondary, the current for the latter going through the same wire as the primary. This allows the apparatus to be much smaller, which means that it costs less than if an ordinary transformer with separate primary and secondary were used. Sometimes if lowering transformers are used with a motor, and their connections and winding permit of it, a voltage lower than normal can be obtained from them; a double throw switch is then sufficient in place of the compensator. Again in quarter phase circuits it is sometimes possible to obtain lower voltages by making various connections of the two phases, in which case also a double throw switch is all that is necessary.

"J. H.": How do you figure the horse power to run a street car? What is the difference between tractive effort and draw bar pull?

Ans.—The power required to operate cars on an ordinary level track, in fair condition, is figured from the following equation:

$$\text{Horse power} = \frac{\text{tractive effort in pounds} \times \text{speed in miles per hour.}}{375.}$$

The tractive effort is usually based on the requirements of a 10 ton car or train being 20 lbs. per ton, for a 20 ton car 15 lbs., and for a 30 ton car 10 lbs. per ton. It should be noted that each per cent. of grade will increase the tractive effort required by the same amount. The difference between tractive effort and draw bar pull is that the former is the term given to the total propelling power generated in any given vehicle; the latter is the net propelling power which the vehicle can exert on something else, after deducting the amount required to move itself.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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New Canadian Industries.

Of late years there have been many encouraging signs given to this country that its future is bright and full of promise of good things to come, not the least among them being the establishing of local agencies or companies by United States firms which hitherto have filled their Canadian orders by exporting home made goods. The past month has seen public announcement made of the intention of two of the larger companies on the other side, the Bullock and the Westinghouse, to establish Canadian factories for the supplying of the business which has hitherto been taken care of by importations. It should be a source of satisfaction to all to see these two added to the many other industries which are just now being started on this side of the line and to feel that the large sums which hitherto have annually been sent away for the purchase of electrical apparatus will now be spent at home. Perhaps we shall some day have the further pleasure of seeing a large industrial company formed to manufacture apparatus of Canadian design. At present, curious as it may seem, but very few of the larger concerns operating in this country are building anything but United States designs ; this being true not only in the electrical but also in the steam engine and water wheel industries. The Canadian headquarters and factory of the Westinghouse interests will be located at Hamilton, those of the Bullock Company in Montreal.

Electric Signs.

New methods for increasing station earnings are always eagerly sought for by operating managers, the latest being that of electrical signs, a field which shows promise of considerable development. These signs may take the simple form of rows or festoons of lights, plain or colored, hung round a building and following its outlines to a greater or less extent, or be put in the shape of reading matter, in which case the lamps are sometimes used purely as illuminators for ordinary signs, but more often they are arranged in the shape of the letters and form the actual words. This latter is again divided into the stationary and the flashing types, the latter offering endless opportunities to make an extremely varied and attractive display with but a comparatively small amount of apparatus. Perhaps the most effective form is that of the script type, in which the lamps are progressively lit with a rapidity which gives the effect of an invisible hand writing in the air. The actuating device or flasher of any of the changing signs usually consists of a revolving cylinder which makes appropriate contacts with the various fingers forming the terminals of the various lamps or combinations. The actuating force is usually a small machine of the fan motor type. The importance which this question of sign and decorative lighting is assuming is evidenced by the increasing number of sockets and receptacles coming into the market, which, primarily designed for mounting in exposed situations, are at the same time very easy to install. Another point which is being brought out by experience is that small lamps of low candle power, which obviously cost less to install, and particularly to operate, than the heretofore standard 16 c.p. lamp, give results which are quite equal to those produced by the larger unit.

"Train Control."

The tremendous strides being made by electric railway apparatus is nowhere so apparent as in the improvements which are constantly being made in the various systems of motor control. It seems to be generally conceded that for anything except what are to-day considered small cars, some method of master or train control is absolutely necessary, and consequently the various manufacturing companies are full of the problem of best meeting these demands. The recent absorption of the Sprague Company by the General Electric Company enabled the latter to add several features of the former company's system, which hitherto were not available to its method of handling this problem. Both these companies use purely electrical apparatus, the Sprague the usual form of drum controller, actuated by a motor controlled by the motorman, the General Electric people preferring to separate the various contacts each into its own simple element, actuated by a coil and plunger. On the other hand the Westinghouse Company, with their well-known predilection for compressed air, developed a system somewhat akin to that of the Sprague interests, but using compressed air as the motive power in place of the small motor. This company has now brought out a modification of their first method which embodies some new and interesting features. The main difference is that, following the practice of the General Electric Company, the grouping of the various fingers and drums into one main controller has been done away with, and individual contactors substituted therefor. These, instead of being opened or closed by the coil and plunger method, are actuated by compressed air, the valves of which are handled by small battery energized electro magnets. The air brake and car controlling systems are so interconnected that the application of the brakes automatically shuts off the current from the motors, if the driver has not already done so. Means are also provided whereby the current is shut off and the brakes applied if the motorman takes his hand from the controller, the same actions taking place if the train should break in two. There is also provided a device to give automatic acceleration, and thus prevent overloads, both on the power house as well as the motors. Further advantages claimed for the system are a great reduction in weight and the power required to operate it. Altogether it appears to possess many marked advantages over its predecessor and will be watched with interest by all those interested in heavy electric traction.

Variable Speed Induction Motors.

The question of variable speed motors is at the present moment a very live issue, and curiously enough in most of the discussions which arise, it appears to be taken for granted that direct current apparatus must be installed if anything but constant speeds are needed. It is, of course, admitted that where continual changes in speed are necessary, and where they extend over a very wide range, that the direct current motor has certain well recognized advantages. On the other hand, where the changes required are not very large, nor called for very frequently, the alternating motor can be made to give very satisfactory service. It is, of course, evident that, if it can do the work, the alternating type is in the great majority of cases the more desirable, as there is then no necessity for introducing motor generator sets or other apparatus for producing direct current. The standard induction motor is essentially a constant speed machine, the voltage and frequency remaining unchanged, but there are several methods by which it can be made to vary, such as altering the voltage applied to the motor, varying the resistance of the secondary, permutating or changing the number of the poles and again by varying the frequency of the current supplied. It is not usually practicable to vary the potential by changing its value as generated, and so some form of transformer compensator or reactance is required, which means additional apparatus and increased losses. Further than this, the losses in the motor are increased with the decrease in voltage, the tongue remaining constant, which means greater heating, or in other words a larger and more costly motor. On the other hand the varying of the secondary resistance means the transferring of these losses to an outside rheostat, thus a smaller machine can be used for a given output. Both of the foregoing methods lend themselves readily to large and continued variations in speed, the latter having the less effect on the voltage of the supply circuit. Permutation, or the variation in the connections of the primary winding so as to alter the number of poles, is obviously restricted in its application, it being scarcely practicable without great complications, to make the same winding suitable for more than two or three sets of poles. This means that the machine is limited to a corresponding number of speeds, and that the changes from one to the other are consequently somewhat abrupt. The efficiencies, however, at the lower speeds are considerably in excess of those obtained by either of the other foregoing methods, which makes the system a most desirable one if long runs are needed at say half or two thirds normal speed. Variable frequencies are generally obtained from two or more generators or a small motor generator set. This method, the voltage being varied with the frequency, gives excellent efficiencies and so is most desirable in that respect, though it introduces the additional cost and complication of the extra apparatus and wiring needed. Concatenation, or the connecting of the field of one machine to slip rings on the primary of the first, is occasionally found in alternating railway work. When so connected both machines run at half speed, the first because of the external resistance, as represented by the field of the second, which has been inserted into its armature circuit, and the second because the currents supplied to it, coming as they do from the secondary of the first machine running at half speed, or 50% slip, are of half the normal frequency.

The Acetylene Construction Company, of St. Catharines, Ont., have secured the contract for installing a street lighting system for Moosomin, N. W. T.

Mr. D. W. Marshall, of Sarnia, Ont., is wiring the new elevator at Point Edward. The contract calls for the installation of a 22 h. p. Robb Amrstrong engine, an 18 k. w. generator, and 150 incandescent and six arc lights.

Coming in contact with a feed wire of the Metropolitan Railway while working with some G. N. W. wires at Richmond Hill, Emile Nadore, a lineman, was thrown some distance in the air and fell to the ground, a distance of twenty-five feet. He sustained an ugly gash in the head and was terribly burrned, but his recovery is hoped for.

THE GROUNDED WIRE AS A PROTECTION AGAINST LIGHTNING.

The important question of the protective influence of grounded aerial wires over transmission lines was discussed by Mr. R. D. Mershon in a paper read at the recent convention of the American Institute of Electrical Engineers, of which the following is an abstract :

There are three ways in which lightning can effect a transmission line—by a direct stroke, by electromagnetic induction and by electrostatic induction. Protection against the first of these would be almost impossible, certainly impracticable. Fortunately, lines are not often struck by lighting. The second, electromagnetic induction, is, in the opinion of the writer, a theoretical possibility—nothing more. It is against the effects of the third, electrostatic induction, that lines are to be protected, whether by lightning arrestors or by grounded wires.

It appears, therefore, that if each wire of a transmission line 20,000 feet in length, the conductors of which consist of No. 00 wire, have stretched parallel to it and at a distance of 12 inches a grounded wire equal in size to the line wire, the potential of the line wire due to a charged cloud could not rise to exceed 30 per cent. of the value to which it would rise if the grounded wire were not present. As a matter of fact, if each of the line wires had its corresponding ground wire, the potential to which they could rise would be even less than this, because each line wire would be influenced not only by its own grounded wire, but by all the other grounded wires also. However, it is not usually the practice to employ a grounded wire so large as that assumed, and 12 inches is a smaller distance from grounded wire to line wire than would usually have place. The usual variation from these quantities will about compensate for the effect due to a greater number of grounded wires as usually arranged, so that the example taken serves its purpose as furnishing a criterion as to the magnitude of the effect of the grounded wires. It does not and is not intended to furnish a criterion as to construction or practical details.

Ground wires are usually of galvanized iron. This material is probably as good from an electrical standpoint as any other, since with the rapid flow which must take place at discharge the material of the wire itself will probably make little difference in the obstruction offered to the flow. The size of the wire will have an important bearing, since in general the larger the wire the less obstruction it will offer and also the greater its "sheilding action." Greater effectiveness will be obtained, of course, for given amount of material, from a number of grounded wires of smaller size than from a smaller number of larger size. Barbed wire is often used for grounded wires, but in the opinion of the writer it has no advantage over smooth wire.

Usually three grounded wires are installed, one on top of the pole and one on each end of a crossarm. They are generally tied to glass insulators, presumably for mechanical reasons, as all three wires are, of course, grounded. The wires should be grounded as often as possible, so that the obstruction to the flow between grounded wire and earth shall be kept as low as possible, thus keeping down the direct action of the grounded wire to as low a figure as possible.

The writer has known of a number of plants where grounded wires were installed. In one of these, as the result of a number of years of operation, those in charge of the plant feel sure that the grounded wires furnish a reliable and effective protection against lightning. In some of the other plants those operating think that the grounded wires furnish more or less protection, but are doubtful as to the amount. In still other plants those in charge feel sure that the grounded wires are of no value whatever, and constitute a nuisance and menace because of their liability to break and fall across the power wires. In some of the cases of doubtful success or failure the trouble may have been due to poor grounds or to the wires not having been grounded frequently enough, as in some of these cases the wires were not grounded at every pole. In all of the doubtful cases lightning arresters which were installed in addition to the grounded wires received more or less discharges during thunderstorms.

The following written contribution to the subject of high tension transmission was submitted by Mr. P. G. Gossler, of Montreal :

In reference to the subject of the grounded wire as a protection against lightning, it may be of interest to the members of the American Institute to know that this method of protection against lightning has been used on the transmission lines of the Montreal Light, Heat and Power Company for the last four years, with very satisfactory results. For three years the transmission lines were operated at two-phase, 12,000 volts, and for the last year at three-phase, 25,000 volts.

The two-phase transmission lines consisted of duplicate lines run from Chambly to Montreal, the total distance being about 17 miles for each line, of which 14½ miles was aerial and 2½ miles single conductor, rubber insulated, underground cables. The underground cable was divided up in three sections. The first section was about a mile and a half from power house, the second about 15 miles from the power house, and the third at the Montreal end.

In the spring of 1902 the two-phase transmission lines were changed to three-phase. The present transmission lines consist of duplicate lines running from Chambly to Montreal, the total distance being about 17 miles for each line, of which 15½ miles is aerial and 1½ miles underground cables. The underground cables are at the Montreal end and are three-conductor, paper-insulated cable. The present arrangement is two three-phase circuits on each pole line, the conductors being 30 inches apart and arranged in the form of an equilateral triangle. Three lines of barb wire are run on pony glass insulators on each pole line, two lines being run on the ends of the top cross-arms 32 inches from the line wire, and the third on a pin on the top of pole.

The barb wire is composed of two twisted No. 12 B. W. G. galvanized-iron wires with one four-point barb every five inches, and is connected at each pole by means of a soldered joint to the ground wire. This ground wire is stapled down the face of the pole and is twisted several times round the butt, after running through an iron pipe about eight feet long, which projects above the level of the ground, preventing the wire from being cut or broken, as well as affording an additional ground. The barb wire is tied to the glass insulators with a No. 12 B. W. G. galvanized-iron wire. The ground wire and pipe were stapled on the pole when the poles were being erected.

As the poles on the transmission lines are set 90 feet apart, the barb-wire lines are grounded about 58 times per mile, this frequent grounding being one of the most important points in the protection.

It has been the opinion of many electrical engineers that ordinary barb wire lacks good mechanical properties, is liable to corrosion and to cause interruption to to the service by breaking and becoming tangled with the transmission wires.

This has not been our experience. In the line described above ordinary commercial barb wire was used, and we have only experienced two cases of the barb wire breaking. In both cases it fell clear of transmission wires and did not become entangled with the conductors. We are of the opinion that our freedom from mechanical troubles has been due to the care exercised when stringing the line, and also by fastening to a glass insulator, instead of stapling to the cross-arms and top of poles. By an inspection of the line after it had been in operation over a year it was found that where the transmission line crossed over the railroad tracks there were signs of the barb wire deteriorating, due to the smoke from passing locomotives. The stretches were consequently removed.

We also use the Westinghouse low-equivalent alternating-current lightning arresters in conjunction with the barbed wire, banks of arresters being located at both ends of the aerial lines.

As is generally known, the climatic conditions in Eastern Canada are often very severe, and during the past four years we have experienced many severe wind and sleet storms in winter and many heavy thunder storms in summer, which storms have often more or less demoralized the local system in Montreal, while the transmission lines have not suffered.

We have undoubted proof of the usefulness of barb-wire protection as applied to our system. The first year and a half of operating our Chambly plant we did not have any protection against lightning but the barb wire. We might state that the first summer of operating we had the oportunity of watching the effect of a very severe storm which travelled from Montreal to Chambly, passing over the district through which our transmission lines run. This storm did considerable damage in Montreal as well as shattering several trees along the transmission line, and also damaged the local lines in Chambly, but no trouble was experienced on the transmission lines.

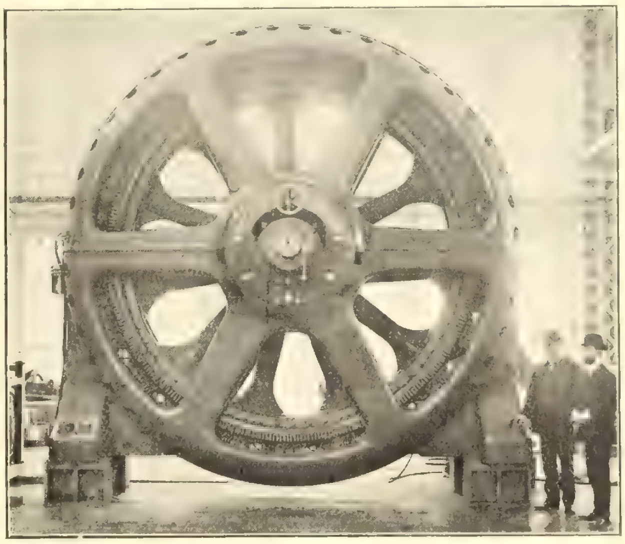
So satisfied are we of the usefulness of barb wire as a protection that we have installed it on many of local 2,400-volt circuits in and around Montreal with satisfactory results.

VALUE OF OIL RINGS IN BEARINGS.

It is probably not generally known that a shaft may be highly insulated electrically from the bearing by the film of oil which envelops the shaft, and that the oil film is capable of withstanding a comparatively high electric pressure. According to some measurements recently made by Dr. A. E. Kennelly and Mr. C. A. Adams, the short circuit of the bearings of a 125-volt 6-kilowatt Edison bipolar dynamo, having a normal speed of 1,800 revolutions per minute, ceased to exist above a speed of 100 revolutions. The electrical resistance was found to be 8.8 megohms in each of the bearings, which were 5 in. long and 1⅛ in. internal diameter. The insulation was found to break down periodically owing to accidental contacts between the brass oil rings and the sides of the bearing slots, but when the rings were lifted it was found that the insulation entirely disappeared, and was not restored until the rings were replaced and set in motion. This experience is a good demonstration of the importance of oil rings in maintaining an adequate flow of oil through a bearing.

BULLOCK INDUCTION MOTOR.

The induction motor illustrated herewith is doubtless entitled to be classed among the largest motors operating in Canada. It is of 450 h. p., and was supplied to the Montreal Water & Power Company by the Bullock Electric Manufacturing Company, of Cincinnati.



Bullock Induction Motor.

LIGHT COSTS.

Prof. Vivian B. Lewes, the celebrated expert, estimates the cost of lighting by various methods, in a lecture recently delivered before the Petroleum Institute of London, England :

Cost of 1,000 Candles Per Hour.

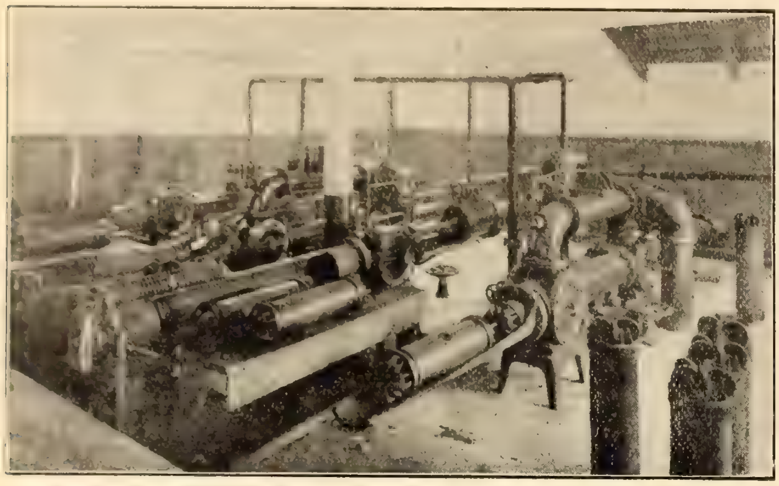
	Cents
Electricty 7 cents per unit :	
Incandescent	28
Arc	7·5
Coal Gas :	
Flat flame	36
Argand	24
Incandescent	4·5
Incandescent high-pressure	3·5
Oil :	
Lamp (oil at 16 cents)	14·5
Oil-gas (oil at 8 cents)	12.0
Incandescent lamp (oil at 16 cents)	4·5
Incandescent air-gas (spirit at 20 cents)	4.0

DOMINION EXHIBITION.

Although the dates set for the Dominion Exhibition at Toronto are Aug. 27 to Sept. 12, the formal opening will not take place until Saturday, Aug. 29, when, under the rules, everything will have to be in place and ready for inspection by the public from 9 a.m. to 10 p.m. All the special features, including Kiralfy's great spectacle "A Carnival in Venice," will be given that day. The Exhibition will be considered officially colosed at 10 p.m. on Saturday, the 12th of September, after which exhibitors must remove all their property from the grounds and buildings. No removals will under any circumstances be allowed before Monday morning, September 14th, except in the case of Live Stock, which may be removed after the parade of prize winners at 2 p. m. on Saturday, 12th September, and Agricultural and Horticultural products, which may be removed after 10 p.m. and 4 p.m. respectively on Saturday, 12th September, and Poultry at 4 p.m. Friday, September 11,

THE BOSTON PNEUMATIC TUBE SERVICE.

The problem of delivering packages is one that confronts every retail dealer in every line of goods. The wholesale merchant can confide his goods to the railroad or steamship company, knowing that at the other end his consignee will unload and take care of the shipment. But the distributor is facing a different problem. He must leave his goods at the homes ot numerous customers, each and every one of whom expects his order to receive immediate attention. This becomes a serious matter in the large cities where the population covers a vast area.



Terminal Station.—Boston Pneumatic Tube Service.

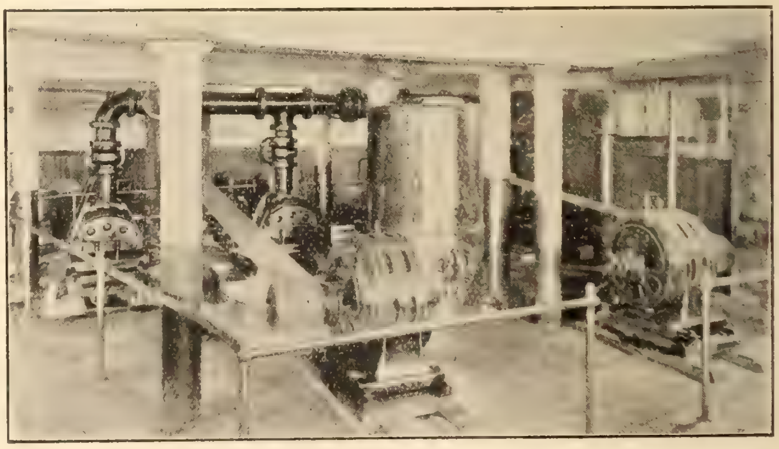
The American Pneumatic Service Company has instituted a novel method of distributing parcels by installing an underground pneumatic tube system in Boston. A central station has been erected in the very center of the retail shopping district at the head of Harrison avenue. From this station two pairs of tubes are laid, one pair running to the Back Bay sub-station on West Newton street near Huntington avenue. The other pair runs to the south end sub-station on Washington street. From the south end the line is continued to the Dudley street station in Roxbury, near the terminal of the elevated road, and from Roxbury it runs to the Dorchester sub-station at Upham's Corner. The parcels are collected from the stores by teams and brought to the central station. There they are sorted and sent by tubes to the sub-stations above named, and delivered trom them by team or messenger. The average time of transit from the central to the Dorchester station is about ten minutes as against forty minutes by team.

The tube is operated by compressed air, which forces a carrier along in a manner similar to that in use in the familiar store service cash system. The air required is about 1,400 cubic feet per minute at an average pressure of 1.9 lbs. With the lines filled with carriers this pressure may rise to as much as 2.1 lbs., and in the shorter lines, with no load, it falls off to 1¾ lbs.

Before entering the compressors the air passes through a tank filled with calcium chloride, which effectually removes all moisture. This tank is open to the atmosphere, and the pipe connections are so arranged that the air of the incoming line passes through the tank and returns to the compressor. Only such air has to be dried as is lost through leakage or used for operating the machines.

The compressors are duplex belt-driven with 24 in. x 12 in. cylinders. There are two each at the main, south end, and Roxbury stations, and one each at Dorchester and Back Bay. The compressors are driven by 50 H. P., three-phase induction motors ot the internal resistance type. The idea ot belted compressors and electric motors was adopted after a long investigation into the relative merits of steam, gas and electric power. Steam was early abandoned because of the necessity of having a licensed engineer at each plant, and on account of the room required for boilers, coal bunkers, etc., gas engines appeared attractive on the score of economy, but it was decided that a power was needed that could be more easily controlled ; that is, one where the starting or stopping of the compressor would be an easier matter. Turning naturally to electricity, the decision lay between direct and alrernating current. The induction current motor with no commutator to burn out, with no danger of burning out the armature, and its high efficiency at half load, was finally adopted. The motors have been running for a year, without giving the least trouble, and with a total bill of repairs of less than five dollars, all of which was for paint.

The carrier used is a complete departure from all previous designs. Instead of using felt or some other substance for bearing rings on which the carrier can slide, five wheels are placed on each end of the carrier. The heads which carry the wheels are slightly flanged and it is found that the air that leaks by is not sufficient to be noticeable. The cover is hinged on the side, opening the whole length of the carrier, and nearly one-half its circumference. It is locked by a trident at each end which slips into holes drilled in the head. Such a heavy carrier cannot be allowed to come out of the open end of the tube the way that small carriers do in the store service systems. The receiving terminal is an air cushion closed at one end by a revolving valve which is opened and closed by a cylinder and piston operated by compressed air from the tube. Normally this valve is closed. When the carrier enters the receiver it compresses the air in front of it. This pressure affects a small auxiliary valve. When the



Electrical Driven Air Compressors—Boston Pneumatic Tube Service.

carrier is brought nearly to rest the auxiliary overbalances and moves the controlling valve of the main cylinder. This opens the revolving valve and allows the carrier to roll out. Just at the end of the receiver two vanes are mounted so that the pressure of the air behind the carrier tends to move them. This motion is made use of to restore the auxiliary valve to normal position and close the receiver. As the current of air is kept flowing all of the time, it is necessary to have some method of introducing the carrier into the tube. This is done by a simple adaptation of the air lock. The valves are moved in the proper sequence by one cylinder controlled as in the receiver.

The pipe used is cast-iron water pipe, machined at the joints to make a close fit. It was laid in the same manner as water pipe, with lead and yarn joints. The curves are of cast-iron, 12 feet radius to center line, the circular section of the straight pipe becoming elliptical at the bend. The bends were cast in sections, the standard 90-degree bend consisting of three 30-degree sections bolted together. In laying, the usual obstacles of manholes, sewers, water and gas pipes and electrical conduits were encountered. To add variety to the work, the foundations of the elevated road and the roof of the subway had to be avoided. On Harrison avenue a long stretch of soft mud was encountered which made it necessary to excavate below grade and put in a bed of good bank gravel. This, when well rammed, made an excellent foundation. Work was commenced September 4, 1900, and the first carrier was sent through on March 10, 1901. Business was commenced June 1, 1901, and has been carried on steadily ever since.—E. D. Sabine, in Railroad Gazzette.

NEW EQUIPMENT FOR THE CATARACT POWER COMPANY.

The Hamilton Electric Light & Cataract Power Company's steam power station in Hamilton, which will be used as an auxiliary to its water-power plant at DeCew Falls, 34 miles distant, is to be equipped with the following machinery recently ordered from the Westinghouse Electric & Manufacturing Company: Two 1,000-kilowatt, two-phase, 2,400 volt, 8,000 alternation, engine-type generators, each driven by a vertical Corliss engine furnished by the Goldie & McCulloch Company, of Galt, Ont; one 50-kilowatt motor-generator exciter set for these alternating-current generators, consisting of one 75-horse-power, two-phase, 400 volt, type C induction motor and a 50 kilowatt, 125 volt, compound-wound, engine-type generator, constituting a two-bearing set; also a switchboard consisting of two generator panels.

In the receiving station of the Hamilton Light & Power Company, which adjoins the auxiliary steam power station in Hamilton, will be installed six 500-kilowatt, oil-insulated, self-cooling Westinghouse transformers with transformer panels, stepping down the current from 20,000 volts or 40,000 volts three-phase to 2,400 volts two-phase.

The two engine-type alternators mentioned above will be operated in parallel with the secondaries from these transformers.

For the water-power station at DeCew Falls, the Westinghouse Company will furnish two 5,000-kilowatt, three-phase, 2,400 volt alternators, which will be direct coupled to water wheels that are being built in Italy; two 100-kilowatt motor-generator exciter sets, each consisting of a 150-horse-power, 2,400 volt, type C induction motor, and two 100-kilowatt, 70 volt, direct-current, compound-wound, engine-type generators, constituting three-bearing sets; five 2,500 kilowatt, oil-insulated, water-cooled transformers, transforming from 2,400 volts three phase to 22,500 or 45,000 volts three phase; together with the necessary switchboards to control the apparatus recently ordered as well as that already installed in the station, aggregating eight separate switchboards with a total of 18 panels, these to be equipped with type F instruments and type C and B oil switches throughout.

POWER CABLE CONDUITS AT NIAGARA.

The Niagara Falls Power Company is making a very important change in the method of running its cables between power house No. 1 and the transformer house. It will be remembered that power house No. 1 and the transformer station are on opposite sides of the inlet canal, the two being connected by a stone bridge over the canal. This bridge was erected for carrying the cables over the canal, and the practice has been to string them through the interior of the structure, but now a new conduit has been built immediately under the bridge.

On January 29 last, it will be remembered, lightning started a fire in the basement of the transformer station, and the flames were carried over the bridge, destroying the cable installation and temporarily putting power house No. 1 out of business. Following this fire, the company built a cable conduit, 805 ft. long and having 24 ducts, from the south end of power house No. 1 around the west side of the Forbes subway, and through 20 of the ducts cables of 1,000,000 circular mils were laid. This relieved the bridge over the canal of some of its cables, and now, says the Eletrical World, the new conduit will entirely do away with the service of the bridge, which is being torn down.

This new cable conduit has 60 ducts, the openings in which are 3¼ inches. The ducts are laid in groups of twelve, and a feature of their construction is that no concrete is placed around them except sufficient to hold them in place. This style of construction was adopted in order that the ventilation might be as free as possible, the difficulty being to get rid of the heat where such an amount of power is carried as passes through this conduit, for all of the load that is transformed, as well as some that is delivered direct, passes over the cables in the conduit. To facilitate ventilation further ventilators have been placed in a walk that is laid over and a little above the conduit. With this change, all of the current from power house No. 1 and also that from power house No. 2 passes through underground conduits, giving much greater security and removing the danger of a repetition of such a disaster as that of last January.

Mr. T. Chouinard, 5 Lee street, Quebec, has invented an electric switch comprising an insulating base, a pair of lateral contacts, a central contact having a tube fixed thereto, a switch-key having a shank rotably mounted in said tube and inclosed thereby for a greater part of its length, a feather mounted on one end of said shank and projecting between said lateral contacts and adapted to contact with either alternately, and a lever-handle attached to the other end of said shank.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, August 6th, 1903.

The Hackman's Union are making determined efforts to prevent the running of tourist trolley cars ticketed "Seeing Montreal"; in fact, they applied for an injunction, claiming the action to be contrary to the charter granted the Montreal Railway Company. Happily, the application for an injunction was dismissed, as it should be; for surely the city of Montreal is not to be made suffer for any such Union. It has suffered sufficiently from Unionism in its various forms for one year at any rate. The cars continue to run and fill a long-felt want, as they cover a large section of the city and suburbs. The remarks of the man on the street, however, are very much to the point, viz., why do not the Montreal Street Railway run these cars themselves instead of sub-letting such tourist traffic to a Yankee syndicate.

Local construction work is very dull, little or no wiring being under way, and the wiremen seeking work are pretty much in evidence, although really good, steady men are generally kept on by their respective employers slack times or no.

Quiet a few representatives from United States firms have paid the Montreal trade a visit since convention time, among which might be mentioned: American Circular Loom Co. (Mr. H. B. Kirkland) Chelsea; American Brass & Copper Co., New York; W. R. Ostrander & Co. (H. D. Monk) New York; Gibson Gas Fixture Co., Philadelphia; Electric Gas Lighting Co. (Mr. Howes) Boston.

The employees of the Montreal Light, Heat & Power Company held their annual picnic on Saturday, August 1st. Sports, games, and dancing were indulged in, and contests were judged by several of the company's officials. The attendance was large and the picnic voted a success.

The fan motor business this season has been a distinct failure owing to cold and inclement weather.

The architects of Montreal almost without exception, when writing specifications for the electric light wiring in residences, etc., are in the habit of stating that the work is to be done in accordance with the rules adopted by the Canadian Board of Fire Underwriters, and with "approved" materials, also that a certificate of inspection to that effect is to be furnished. The next move is to proceed to repeat the Underwriters' rules, stating that rubber covered wire, porcelain insulators, etc., shall be used and other superfluous advice already fully covered by their preamble. All that is necessary to let the contractor know in addition to the preamble already quoted, is the number of outlets, capacity of lights to be carried on each, the location of such outlets, and switch outlets. The architect might also remember that the day is gone past when electric light wires can be pushed into a chink in the brick work or any other hole or corner. A certain quantity of right of way is necessary for a good job.

NIAGARA AND ITS POWER.

The Commissioners of the Queen Victoria Park, Niagara Falls, have issued their seventeenth annual report, in which, concerning the power development at the Horse Shoe Falls, they say: "The production of electrical power as a means of providing revenue has perhaps more than anything else been characterized as vandalistic in its ultimate effect upon scenic conditions in the park. It should be borne in mind that at the time the park was established the science of producing electrical energy for motive purposes was practically in its infancy, the first electrical street railway in America having been put in operation in 1887. It was only when the practicability of transmitting electrical power assumed shape that the matter was considered by the commissioners as a possible means of revenue. The commissioners do not claim that they acquired the portion of the park lying south of Cedar Island looking to the utilization of this portion of the property as being eminently suited for the purpose. They do claim, however, that their recommendation to the Government which brought about the acquirement of this additional property has resulted in the greatest pecuniary advantage. Had the property not been expropriated when the park was founded—viewing it now in the light of what has transpired on both sides of the river—that part of the property would doubtless have been acquired by capitalists and laid out as a manufacturing district without reference to its scenic environments, as has been done on the American side of the river north of the steel arch bridge, to the irreparable disfigurement of the river bank. On the other hand, had it been expropriated after its capabilities as a center for production of electrical power on a large scale were demonstrated, it is quite probable that the price of such expropriation instead of the original cost of $100,000 would have been many millions of dollars, determinable only by the capitalization of the revenue obtainable from possible electrical franchises.

"Coming now to the charge that the commissioners have, in granting certain power privileges, committed acts of vandalism that will ultimately ruin the scenery of Niagara Falls, the commissioners have to state that with the exception of the Ontario Power Company's power house in the gorge under the falls, hereafter referred to, all the proposed works connected with the generation of electricity are practically beyond the territory originally designed for park purposes. When the electrical power works are completed not a single view of the falls, rapids or gorge under the falls will be obstructed in the slightest degree. On the contrary, the filling in of the shore line above the falls by excavated material from the tunnels will increase the park area very considerably and will permit of roads and walks being constructed on the margin of the river which will greatly improve the views of the upper rapids, and at the same time cover the foreshore, which in some places has become exposed by the recession of the waters, owing to the breaking away of the cataract. The waters forming the Dufferin Islands will be completely restored and improved by the construction of cascades and miniature falls, and, besides, the area at that congested point in the park will be considerably enlarged.

"Respecting the construction of the Ontario Power Company's power house in the gorge under the falls the commissioners of the State reservation made representations to the board in July last and were granted a hearing with particular reference to the erection of the structure at the location, the contention of the commissioners of the State reservation being that the building would not only disfigure the landscape as viewed from several points in the American reservation, but would also be objectionable from an æsthetic standpoint and at variance with the natural conditions desired by the commissioners on both sides of the rivers.

"On the other hand, it was shown by the Canadian commissioners that the location of the building in question would present no obstruction to the free views of the falls or river from any point on the American side, and as the building would be far below the surface level of the park a part of the roof and two gable ends would be the only parts of the structure seen from any point of view within Queen Victoria Park. It was further pointed out that to make the building in any sense a conspicuous or objectionable feature of the landscape would depend solely upon the design and character given to it.

"The commissioners have also arranged for the early removal of the large and unsightly building which is so conspicuous from the American side, and which was originally constructed for a museum, but which has recently been used for a restaurant and shelter building. The removal of this structure, which has formed quite a striking feature of the park, and the substituting of a modern refectory near the center of the picnic grounds, will remove from the park one of its most objectionable features, and will more than counter-balance any temporary disfigurement which the construction of the power house may cause.

"All of the works and structures connected with the electrical power projects have been designed with the object not only of doing the least possible injury to scenic conditions, but the commissioners are confident in the belief that when the several works are completed the consensus of opinion by the vastly increased numbers of visitors who are expected to visit the park will abundantly sustain them in their contention that the park, as a whole, with its wealth of electrical machinery, will then be of tenfold greater interest to the great majority visiting it. In addition, not only will the immediate locality beyond the park be built up into one of the great manufacturing centers of the world, but the quickening impulse and vivifying effects of the whole of the world's latest and most perfect form of energy—created and sent forth by the Falls of Niagara—will be felt from end to end of the province."

TELEGRAPH and TELEPHONE

CONGRESS OF WIRELESS TELEGRAPHY.

The First International Congress of Wireless Telegraphy convened by the Imperial Post Office, opened in Berlin, Germany, on August 4th last. Forty-four delegates attended, representing Germany, Russia, France, Italy, Austro-Hungary, Spain, and the United States.

The Congress was called upon Germany's invitation with the avowed purpose of agreeing on international regulations to control the operation of wireless telegraphy systems, and prevent any one system getting a monopoly. The proceedings are secret.

TELEPHONE COMPETITION.

Some of the western Ontario papers are still keeping up their demand for a competitive telephone service. They may have some excuse for the agitation, but it is most difficult to see it at this distance. If there is any one public utility in which it is desirable that a monopoly should exist it is in that of telephones. Experience has taught those localities which have had a competitive system that far from being a source of benefit to the community, the competition has actually resulted in what is far worse than loss—waste. The merchant has not found any profit in being compelled to install two services when one would have answered equally well. As a matter of fact the proportion of duplication has been as high in many cases as 50 per cent., that is half the telephone users were paying nearly twice as much as necessary in order that the other half might have the benefit of competition. Experience has also shown that this competition has been comparatively short lived. It has usually been founded upon cheapness, and if there is anything on earth in which cheapness is detrimental to satisfactory service telephone communication is that thing. The result has usually been that the weakest organization has finally been compelled to retire from the fight with a heavy loss to those who put their money in the venture, and a more or less serious disturbance of the telephone service of the community. In many instances these investors have been led into the loss of their money by the fairy tales of promoters. It is generally easy enough to provide figures which will show a certainty of returns, but it is quite another matter to provide dividend cheques which will be honored at the bank. There is no one who realizes this more clearly than the promoter, and this may be one of the reasons why his cash contribution is usually small, if not entirely lacking.

The public demand is best served by one company. There should, however, in the case of a constituted monopoly such as this, be some provision for the protection of subscribers from extortion, and in this respect Canada occupies a somewhat peculiar position, the control of the rates being vested in the Governor-General-in-council, who may in case of complaint by any municipality fix the rates or appoint a judge of one of the Superior Courts to hold an enquiry, compel the attendance of witnesses, examine them under oath and require the production of books and papers. Under the provisions of these regulations the company is compelled to show that the rates it proposes or which it objects to are either absolutely essential for the purpose of providing a fair return upon the capital investment, or that they are so low that it will be impossible to secure such a return. Not only are local rates covered by this act, but also long distance rates, so that if the company takes advantage of any municipality it is its own fault, at least until it has been demonstrated that the relief provided is inadequate. It is somewhat strange that despite the fact that this law has been upon the statute books for more than a year, not a solitary attempt has been made to set its machinery in motion, though there have been more or less frequent complaints, more or less loud, in the usual vein, of extortion, etc. If the people of any municipality are being robbed it is their own fault. That there is still talk of attempts being made to secure a reduction of rates by the organization of new companies, while the method provided by law remains untested, may be considered conclusive evidence that the basis of the proposed opposition rests upon the hopes of self-aggrandizement of the promoters at the expense of those whom they may be able to lead into their venture, rather than upon any desire to benefit the public at large. It is just as well that the man with money looking for an investment should bear this fact in mind.—Montreal Gazette.

MUNICIPAL SERVICES AT FORT WILLIAM.

The municipal telephone plant at Fort William does not appear to have been the success that has been claimed for it, judging from the following statement in the "Times-Journal" of that town of 23rd July, over the signature of Mr. A. F. Woodhead, a prominent citizen :

"The public (electric light and telephone) services have been administered with inefficiency and inaptitude, culminating in the destruction of the town hall, with its valuable records, a costly law-suit in which the town has been signally worsted, and to-day we have another breakdown in the electric light plant, simply through sheer mismanagement, which will cost a large sum and deprive the citizens of light for probably some weeks. The municipal telephone service is so bad that every user of it is disgusted and supporters of legitimate public ownership are chagrined and disappointed."

SHORT-CIRCUITS.

The DeForest Wireless Telegraphy Company is removing its instruments from the station on Point Hill, Hamilton. The experiments were successful, but commercially it has not been profitable.

A new agreement with the Bell Telephone Company and the city of Hamilton is being drawn up. The prices for 'phones will remain the same, but all will be fitted out with the long-distance equipment. The agreement will last for five years, and the company will pay $2900 a year and a bonus of $1,450.

Mr. James Kent, general manager of C. P. R. Telegraphs, accompanied by Mr. D. S. Jenkins, the western superintendent of the company, has just completed an inspection of the lines between Winnipeg and the Pacific coast. New copper wires are being strung from Winnipeg to Brandon, Napinka and Minnedosa, and from Calgary to Macleod.

Mr. Frank G. Walsh, general superintendent of the Bell Telephone Company's western lines, has announced the appointment of Mr. John R. Richardson to the position of manager of the Winnipeg office. Mr. Richardson has been with the Bell Company almost continuously since the opening of the Winnipeg branch and is very popular with the public.

CHIMNEYS.

By W. H. Wakeman.

The following rules concerning the construction of chimneys are very suggestive, and it appears as if they might be safely followed in practice :

The foundation of a chimney may be composed of concrete, brick or stone, according to which is the most convenient. Concrete is preferred, as it secures a better bearing than large stones, because they only rest on the soil in spots until a great weight is put upon them, when there is a chance for them to settle unevenly. On the other hand, concrete rests evenly upon the soil when first laid, and, as it hardens, it becomes one solid mass, forming a superior foundation.

Concrete should be laid about one month before the chimney is to be built upon it, in order to give it a chance to firmly set before it is required to support the great weight that is to follow. If it rests upon clay or loam, it should be large enough to reduce the weight resting upon it to two tons per square foot, but if there is a thick bed of gravel to build on the load may be increased to four tons per square foot. If the soil is spongy it must be excavated down to something more solid, but if this is not practical, piles must be driven down until they reach soil that supports them firmly.

The external diameter at the base should not be less than one-tenth of the height; and the outside batter may be from one-sixteenth to one-quarter inch per foot, according to the judgment of the designing engineer. The location of it will assist about deciding this point, for if it is to be exposed to fierce gales it will need to be broader at the base, hence will naturally have the greater batter, but if it is surrounded by high buildings the batter may be less, for obvious reasons.

For chimneys from two and a half to say five feet in diameter the upper part for eight or ten feet need be only one brick, or eight inches thick. For those exceeding five feet, a wall twelve inches thick is right. The whole should be so planned that the walls shall decrease in thickness (as the superstructure increases in height) at the rate of four inches for each twenty or twenty-five feet.

The cap should either be made in one piece, or, if composed of several, they ought to be firmly bound together, but wrought iron bands should never be used for this purpose, as they rapidly oxidize and are unsatisfactory on this account. It is obvious that a cap should be as heavy as possible, yet small, so as to avoid presenting too much surface for gales of wind to act on.

The flue may be built of uniform diameter its full length, or it may be slightly contracted at the top without reducing the intensity of the draft. Sone engineers prefer to have a flue larger at the top, but this does not improve the draft, yet it renders the construction more difficult, hence more expensive, without giving adequate returns.

This was proved in at least one case. It was an iron stack that was larger at the top as originally constructed, but during the course of other changes at that plant this was reversed and put on the same foundation, to be used under like conditions as formerly, but the draft was not affected by the change.

We are sometimes told that chimneys should never be built into buildings, and this is a good rule to go by. Still there are exceptions to it, for sometimes a chimney forms part of a building without objectionable results.

One objection presented to this plan is that when a chimney is built independently of other structures it is swayed by the wind. If a high chimney is to be built near a one-story boiler house it had better stand alone, but where the building is nearly as high as the chimney, which is frequently the case, it must be held by the building, hence this objection is dispensed with.

The expansion of a chimney is greater than the walls of the building, when heavy fires are carried under the boilers, and while this is an objection, it is at least partially overcome by building the core independent of the outer walls, with a good air space between them. While this is expensive, it is necessary in order to provide for expansion of heat, whether the chimney stands alone or forms a part of some building.

This air space should be covered at the top to prevent ashes and cinders from collecting in it, but at the same time care must be taken to prevent binding the two together, as such a plan will destroy the outer wall near the top.

We find that some engineers believe that a lightning rod on a tall chimney is of no benefit, probably because a defective rod has not afforded full protection to some other chimney, but how are we to tell how many times a well laid rod prevents damage by lightning.

If it is carried well down into earth that is always moist it may carry off much of the dangerous fluid without making much fuss about it, hence it is some what like a good steam engineer, as neither gets full credit for the damage they prevent.

About a year ago an imposing chimney was built in a northern city, and when finished the scaffold used was taken down, but a few days ago workmen were said to be erecting another scaffold around that chimney, and investigation disclosed the fact that lightning had damaged the top of it, causing numerous cracks, but not displacing any of the bricks.

A short distance from it stands another chimney, above the top of which appears the points of two rods, and as this is a new one it is very plain to even the casual observer that the owners of it are profiting by the misfortunes of their neighbors to the extent of avoiding their mistakes.

When we consider the comparatively narrow or small dimensions of a chimney foundation, then compare it with its height, it becomes plain at once that a slight imperfection in the foundation, causing it to settle unevenly, although to a small extent, must affect the shaft to a much greater degree. It is both unpleasant and unsafe to have a tall chimney leaning to one side, therefore measures must be taken to correct the evil, and this can be accomplished by sawing out some of the bricks on the high side and putting thinner ones in their places. This allows the high side to settle, bringing the shaft into a vertical position, provided good judgment is used in reducing the size of the bricks, for if they are made too thin the effect might be disastrous, especially if the brick structure is surmounted by a heavy cap, which is needed to make the whole thing more solid, and thus prevent excessive swaying.

Another plan for plumbing a leaning chimney is to weight the high side of the foundation, or to puddle it until it settles enough to afford a remedy, but this is more dangerous than removing some of the bricks, for the simple reason that there is no way for telling just when the puddling has reached its highest state of perfection, making it risky to prolong the process.

Steel chimneys or stacks are no longer a novelty, which are so designed and constructed that no braces are necessary. The lower courses of such a chimney must, of necessity, be made of thick plates, in order to stand the heavy strain put upon them by bolting them down to a heavy masonry foundation, after which the pressure of wind against the upper parts causes a very great leverage to be brought to bear on the lower courses.

Such a chimney looks well and gives good results in practice, but it is more expensive than one supported by guys, because the absence of support to the upper parts makes a much more elaborate foundation necessary, also increases the cost of the lower part of the chimney itself.

A steel chimney or stack is less liable to be destroyed by accident than one composed of brick, as the latter cannot be held as rigidly together as one made of plates riveted to each other.

The larger sizes of steel chimneys are lined with fire brick, in order to prevent rapid destruction of the lower plates, and to retain the heat as much as possible, for if the hot gases are quickly cooled it tends to reduce the intensity of the draft.

More attention has been given to the design and construction of chimneys during the past few years than ever before, resulting in fine specimens of both steel and brick structures, that are ornamental as well as useful.—The Tradesman.

The Review of Madoc, Ont., states that owing to a number of accidents the electric light plant there has been closed down permanently, and that the citizens are in favor of taking steps to install a new plant.

STEAM VS. ELECTRICITY.

The Prussian State railways between Hamburg, Hanover and Berlin will shortly conduct an interesting competition between steam and electrically hauled trains. The leading locomotive builders and electrical firms of Germany have been invited by the State to submit designs and specifications for steam or electric locomotives or motor cars capable of making 100 miles an hour with a light load, and 90 miles an hour on ordinary traffic.

The tests will be a continuation of the trials of high speed electric trains on the Prussian standard guage military line between Berlin and Zossen, which have been arranged on account of the decision to increase the speed of trains between Hamburg, Hanover and Berlin.

Elaborate reports have just been published of the Berlin to Zossen tests. It must be borne in mind, however, that this is a line of only fourteen miles, and is practically staight, and without any curves of a radius less than 6560 feet and no gradient steeper than one in 200. In the first trials a car built at Cologne and electrically equipped by the Siemens-Halske Company of Berlin, attained for a very brief period a speed of 160.2 kilometres, or nearly 100 miles an hour, but the tests were abandoned owing to the giving away of the rails. They were too weak for the car, which weighed over ninety-two tons.

It is reported to be the intention of the Wiarton Electric Light Company, Wiarton, Ont., to install an incandescent system throughout the town.

The Shawinigan Water & Power Company, of Shawinigan Falls, Que., have closed a contract to supply power to the city of Sorel, Que. This will necessitate the building of a twenty-mile transmission line from Jolliette through the village of Laprairie to Sorel. From Lanorae the line will cross the St. Lawrence river by means of a submarine cable.

TO THE TRADE

WE are now in a position to fill orders promptly for Knife Switches of any size from 10 to 1000 Amperes. We have a modern up-to-date factory, using best methods, and making prompt deliveries. We solicit your trade.

The Hill Electric Switch Co., Limited, 426 St. Paul Street
MONTREAL

BELTING FOR ELECTRIC WORK.

The Rossendale Belting Company, Ltd., of Manchester, England, have opened a branch at Toronto, for the sale of their belting. The various productions of this company have for several years undergone severe tests in all kinds of work in the Dominion, and the quality of the goods has always been maintained.

The belt primarily adapted for electrical work is the "M. A. Y." brand. The following test was made by the Messrs. Galloways, Limited, at Manchester, on May 25th last :

				THICKNESS
No. 1 Test.—	5 in. Single Leather	............broke at	2,000 lbs.	¼ in.
" 2 "	5 in. Double Leather, copper sewn	"	4,500 lbs.	⅜ in.
" 3 "	5 in. Treble Leather, copper sewn	"	6,500 lbs.	½ in.
" 4 "	5 in. ROSSENDALE M.A.Y. BELT	"	10,200 lbs.	¼ in.

These belts will run under all conditions, exposed or damp places, heavy or light work, fast or slow speeds, main drives, etc.

SPARKS.

The town council of Renfrew, Ont., have passed a by-law to raise the sum of $88,390 for the purpose of acquiring the water power, dam and electric light plant of the Renfrew Power Company, Limited, and the Renfrew Electric Company.

The Stratford Gas & Electric Light Company, of Stratford, Ont., held their annual meeting early in August. The statement presented showed the past year to be the most successful yet experienced. Dr. S. A. King, of Windsor, was appointed president, and Mr. Baxter was re-elected managing director.

The Roberval Electric Company, Roberval, Que., have recently placed an order with J. C. Wilson & Company, Glenora, Ont., for a 28-inch deep bucket "Little Giant" turbine with horizontal mounting. The same firm have under construction a 12-inch wheel of the same type for J. A. Kirk, Arrowhead, B. C.

Messrs. A. Alabaster, Gatehouse & Company, 4 Ludgate Hill, London, E. C., have issued a valuable work entitled "Secondary Batteries." The main object of the writer has been to instruct persons in the work of attending to a storage battery. It is written by an engineer and contains numerous illustrations which serve to enlighten the reader.

The contract for building a power house for the Vancouver Power Company has been given to Jonathan Rogers. The power house will be built below the Trout Lake dam on the north arm of the inlet, and will be a stone building 40 x 156 feet. The wall will be 30 feet in height and 2½ feet in thickness. The company expect to have 4,000 horse power available by the end of the year.

Since the 1st of May, when J. C. Wilson & Company, Glenora, Ont., manufacturers of the Little Giant turbiue, reported their foreign shipments as twenty-one turbines, they have shipped the following additional wheels, namely, two 12-inch, one 21-inch, one 28-inch, and one 44-inch, all of the vertical style. They also have under construction, to go abroad, one 14-inch, one 21-inch and one 24-inch.

The electric light committee have presented to the town council of Almonte, Ont., a report regarding improvements to the electric light plant. The first proposition is to lower the present wheel and build new frame and bulkhead, at a cost of $4,800. Another proposition is to build a new power house, including open waterway and new bulkheads and dynamo, at an approximate cost of $12,000. Still another proposition calls for an expenditure of about $25,000 on improvements and new plant.

The Peterborough Hydraulic Power Company, of which Senator Geo. A. Cox is president, is building a new power plant on the Otonabee river, in the Town of Peterborough, which will be equipped with the following apparatus recently purchased from the Westinghouse Electric & Manufacturing Company : A 1500 kilowatt, 2240 volt generator, having 7200 alternations and running at 150 revolutions per minute, to be direct connected to water wheels ; also two 125 volt, D. C., direct coupled exciters of 75 kilowatts capacity each ; together with switchboard consisting of a large generator panel and two exciter panels. This power house, when completed, will be an unusually fine one and is to furnish power to the Peterborough mill of the American Cereal Company, owned by the Quaker Oats Company ; power will be supplied to several other manufacturing plants in the town and also to the Peterborough Light & Power Company, which does an electric lighting and small power business in Peterborough.

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We are prepared to receive
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Laurie Engine Company
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SPARKS.

On August 10th the ratepayers of Regina, N. W. T., will vote on a by-law to raise funds to install an electric light plant.

The city council of Montreal have engaged Mr. Charles E. Phelps, of Balitmore, to report upon the building of a conduit system for the electric wires in that city. The companies interested are the Montreal Heat & Power Company, Montreal Street Railway Company, Merchants Telephone Company, Great North-Western Telegraph Company, Terminal Railway Company, Canadian Pacific Telegraph Company, and Bell Telephone Company.

The Halifax Tramway Company, of Halifax, N. S., expect to expend upwards of $200,000 on improvements, some of which have already been completed. The new station will be completed before the end of the year and will then have a capacity of 45,000 horse power. In the operation of the generators and engines the use of belts has been entirely done away with.

The town council of Orillia, Ont., are disposed to continue the expenditure of money until the power plant at Ragged Rapids shall fully meet the requirements of the town. It was recently decided to extend the plant, and tenders for the work were invited. For the hydraulic machinery the Jenckes Machine Company, of Sherbrooke, tendered at $9,941, and the William Hamilton Company, Peterboro, at $9,250, the latter tender being accepted. For electrical apparatus the tenders were as follows: Canadian Bullock Company, $22,700; Canadian General Electric Company, $21,563; Westinghouse Electric Company, $21,319.14; United Electric Company, $20,450. The contract was secured by the Westinghouse Company. Mr. H. Von Schon, of Sault Ste. Marie, is acting as engineer for the town.

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1-5 H.P. S.K.C. Motor, 8000 Alts., 500 volts, with necessary Transformer 1000-2000-500.

1-25 K.W. R. E. Co. B-iPolar D. C. Dynamo, wound for 110 volts, with sliding base, pulley, brushes, etc., complete.

2-12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.

The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address

THE VOLTA ELECTRIC STORAGE CO.,
39 James street South,
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GASOLINE ENGINE

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Buys the 2 h.p. "Triton Special" marine gasoline engine, with propeller and complete outfit.

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SEND FOR TABLE OF CONTENTS.

SPARKS.

The capital of the St. John Street Railway Company has been increased to $800,000.

The Montreal Street Railway Company have increased their capital by $1,000,000.

The Westport Electric Light Company, Limited, of Westport, Ont., has obtained a charter of incorporation.

The Hamilton Electric Light & Power Company have sold the engines in the Catharine street power house to the Firstbrook Box Company, of Toronto.

The New Brunswick Government has granted incorporation to the Consolidated Telephone Company, to operate a telephone system in Carleton county.

The directors of the Ottawa Electric Railway Company have decided to issue the remainder of the company's capital stock to the present shareholders at par.

An electric light plant will be installed in the new Windsor Hotel about to be built at Stratford, Ont., the plans for which were prepared by Messrs. Orr & Russell, architects, of that city.

The new building for the Montreal Stock Exchange will contain telephone stands with accommodation for 64 instruments. Particular attention has also been paid to the lighting and ventilation of the building.

The Fredericton Gas Company, of Fredericton, N. B., have accepted the city's offer of $15,500 for their electric light plant. The plant will be taken over upon the expiration of the contract in October, when the city will install new boilers.

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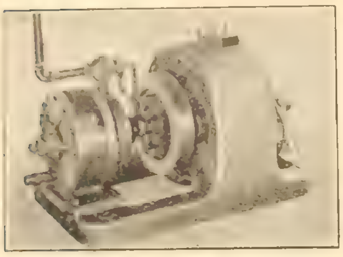

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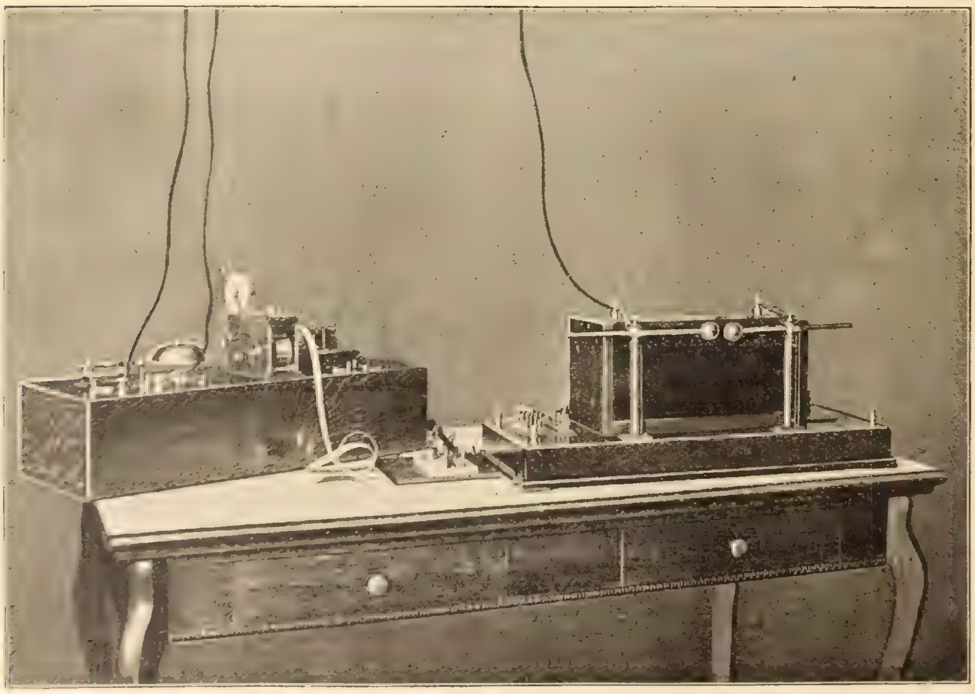

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Clark Wireless System has shown its merit in all tests and requirements. We can fill your order promptly, for high grade apparatus.

Thos. E. Clark Wireless Telegraph-Telephone Company,
DETROIT, MICH.

SPARKS.

The British Columbia Electric Railway Company have just taken tenders on the erection of a distributing station at Vancouver.

The Stratford Radial Railway Company are negotiating for right of way, etc., for a branch of their electric railway running from St. Mary's to Sebringville.

The Denver Light & Power Company, Limited, of New Denver, B. C., have applied for certain rights under the Water clauses Consolidation Act. The company propose to establish a power plant to generate electricity for lighting the towns of New Denver and Silverton.

Among recent orders for Little Giant turbines placed with J. C. Wilson & Company, Glenora, Ont., is one from A. B. Lees, Fallbrooke, Ont., for a 33 inch vertical, also one from Copeland & Ziegler, of Salem, Ont., for a 21 inch wheel, of the deep bucket pattern.

The Eclipse Electric Company, of 81½ King street east, Toronto, has been amalgamated with the James Morrison Manufacturing Company and is now operated by their works at 89-97 Adelaide street west. This company has the contract for the electrical equipment of the Toronto Opera House and the Metropolitan church.

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In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

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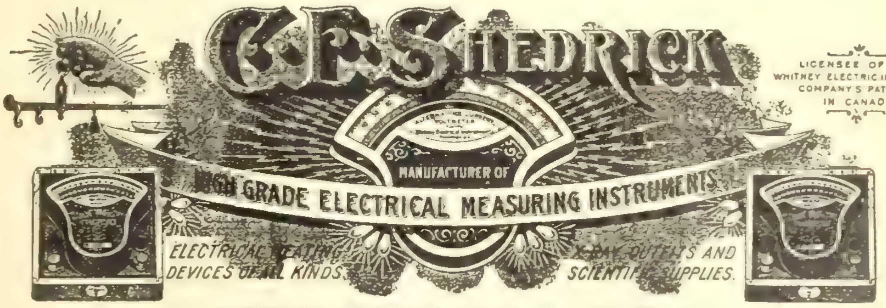

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TRADE NOTES.

The Cantin Company, Warwick, Que., who recently installed a 28-inch Little Giant turbine, have placed an order with the makers, J. C. Wilson & Company, Glenora, Ont., for a Walsh improved double-acting water wheel governor.

In their advertisement appearing on another page of this number, Messrs. Collyer & Brock announce that they have equipped a new factory at No. 1801 Notre Dame street, Montreal, for repairing all types of dynamos, motors, transformers and arc lamps. They will be pleased to quote prices for this line of work.

The Pittsburgh Transformer Company, Pittsburg, Pa., is in receipt of a letter from the Atlantic Coast Electric Light Company regarding the operation of Pittsburgh transformers on this company's system. Mr. John F. Kellers, the superintendent, states that during one severe lightning storm in the early part of last August, twenty-three transformers of other makes were destroyed, while the Pittsburgh transformers remained uninjured. During the past five years this company say they have not burned out a single Pittsburgh transformer, nor has any of them caused the slightest trouble.

The Pittsburgh Transformer Company announce that they are distributing each month one of their Pretty Girl Calendars. These bid fair to be popular and the company wishes to place them in the hands of every one interested in its product. If you do not get the calendars regularly, write them to that effect and your name will be placed upon their mailing list.

Among recent shipments of "Little Giant" turbines by J. C. Wilson & Company, Glenora, Ont., are a 21-inch vertical to W. Corey, Upper Bedford, Que.; a 24-inch vertical to Edson Fitch Company, Etchemin, Que.; a 21-inch vertical to Jos. Labrie, Rimouski, Que.; a 28-inch deep bucket vertical to The Skumin Company, Gananoque, Ont.; and two 33-inch verticals to Stuart Bros., Mitchell, Ont.

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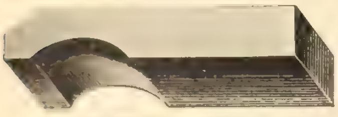

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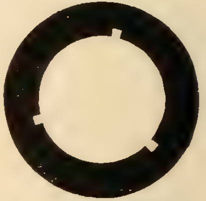

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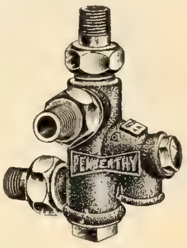

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SPARKS.

Messrs. Moore & Sons, of Meaford, Ont., are developing a water power near that place.

The village of Fenelon Falls, Ont., is issuing debentures for the purpose of purchasing a water power and electric lighting plant.

It is said that American capitalists are seeking to acquire the rights and interests of the Stave Lake Power Company, at Coquitlam Lake, B. C., the object being to transmit the power across the border.

The Metropolitan Railway Company are prospecting for an extension of the road northerly from Newmarket, with an objective point at Barrie or Sutton on Lake Simcoe. Surveys have been made under Mr. James McDougall, C.E.

J. C. Wilson & Company, Glenora, Ont., have an enviable reputation for the quality of the gear wheels turned out in their works. Finished on special machines, the teeth, both iron and wood, being dressed on both sides, are made mathematically correct, insuring the least possible loss of power through friction.

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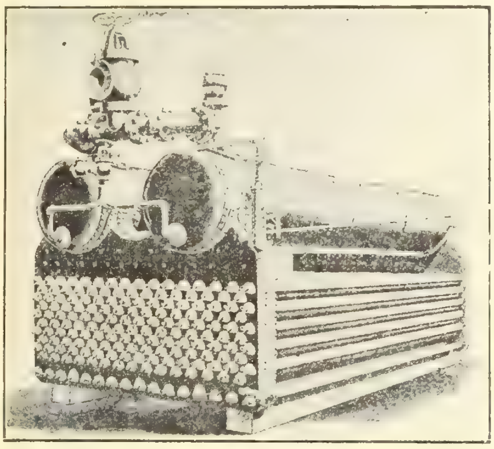
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SPARKS.

The Oshawa Electric Light Company, Oshawa, Ont., are installing a 120 horse power wheel supplied by Madison Williams, of Port Perry, and a steam engine from the Goldie & McCulloch Company, of Galt.

Mr. T. T. Simpson, of Ottawa, is acting as consulting engineer for a company which intends developing the water power at McPherson Falls, on the Vermillion River, near Sudbury. A large plant will be installed at once and power transmitted for some miles for use in the various mines in that section.

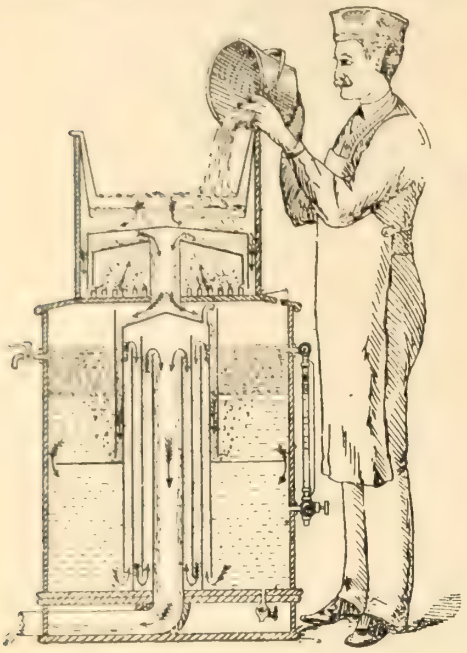

PLATE 2, Sectional View of Filter.

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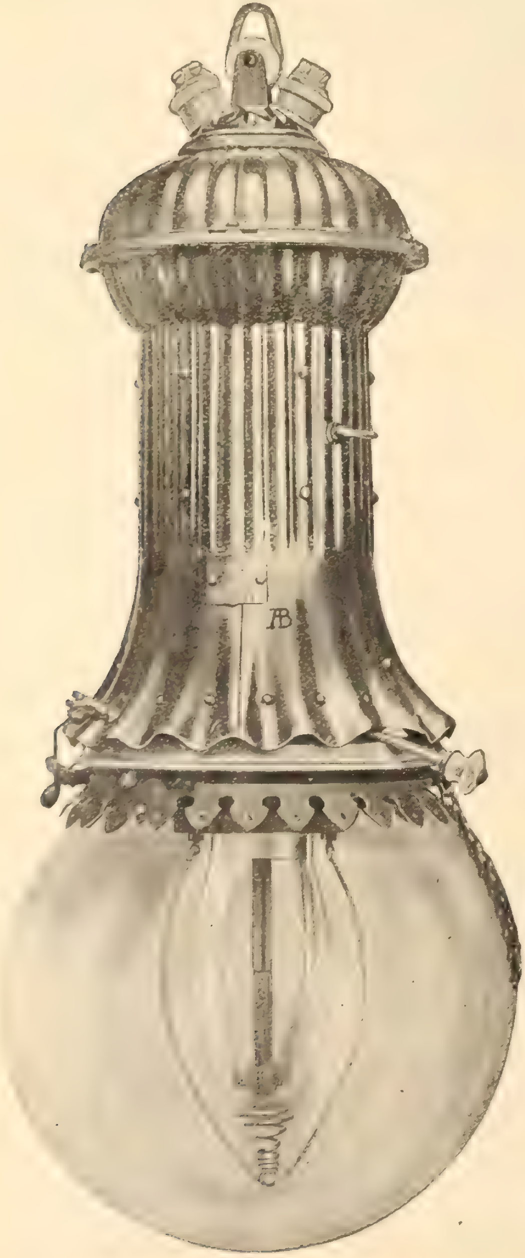

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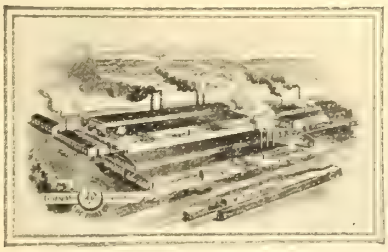

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Where they go.

Views of Penstock Work.

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SPARKS.

Mr. Flaherty, of Boston, is making some headway with the scheme to connect Trenton, New Glasgow, Stellarton, and Westville, N. S., by means of an electric railway.

The Canadian Bullock Electric Manufacturing Company, Limited, has been incorporated, with head office in Montreal. The directors are Messrs. A. E. Greenshields, A. F. Cayford, R. T. Hencker, F. H. Leonard, jr., and A. Collyer.

Directors and officers of the Niagara-Welland Power Company, of St. Catharines, have been elected as follows: President, Harry Symons, Toronto; vice-president, C. A. Hesson, St. Catharines; secretary-treasurer, J. S. Campbell, St. Catharines; directors, C. J. Crowley, New York; James Haydon, Camden East; and S. R. Hesson, Stratford.

An agreement between the city council of Woodstock, Ont., and the Bell Telephone Company has been reached. It provides for the extension of the company's franchise, which expires next January, for five years from that date. The annual charge of $200 has been cancelled, in consideration of which the company is to put its wires underground on several streets.

Another conference of representatives from the various municipalities in western Ontario interested in the development of Niagara Falls power was held at Berlin on June 9th. Delegates were present from London, St. Thomas, Stratford, St. Mary's, Galt, Guelph, Berlin, Waterloo and Bridgeport. The unanimous opinion appeared to be that the new power works act should be taken advantage of by the municipalities, and that steps should be taken unitedly by the municipalities to obtain, if possible, power from Niagara Falls. A committee was appointed to gather information and to take steps towards forming a union of municipalities.

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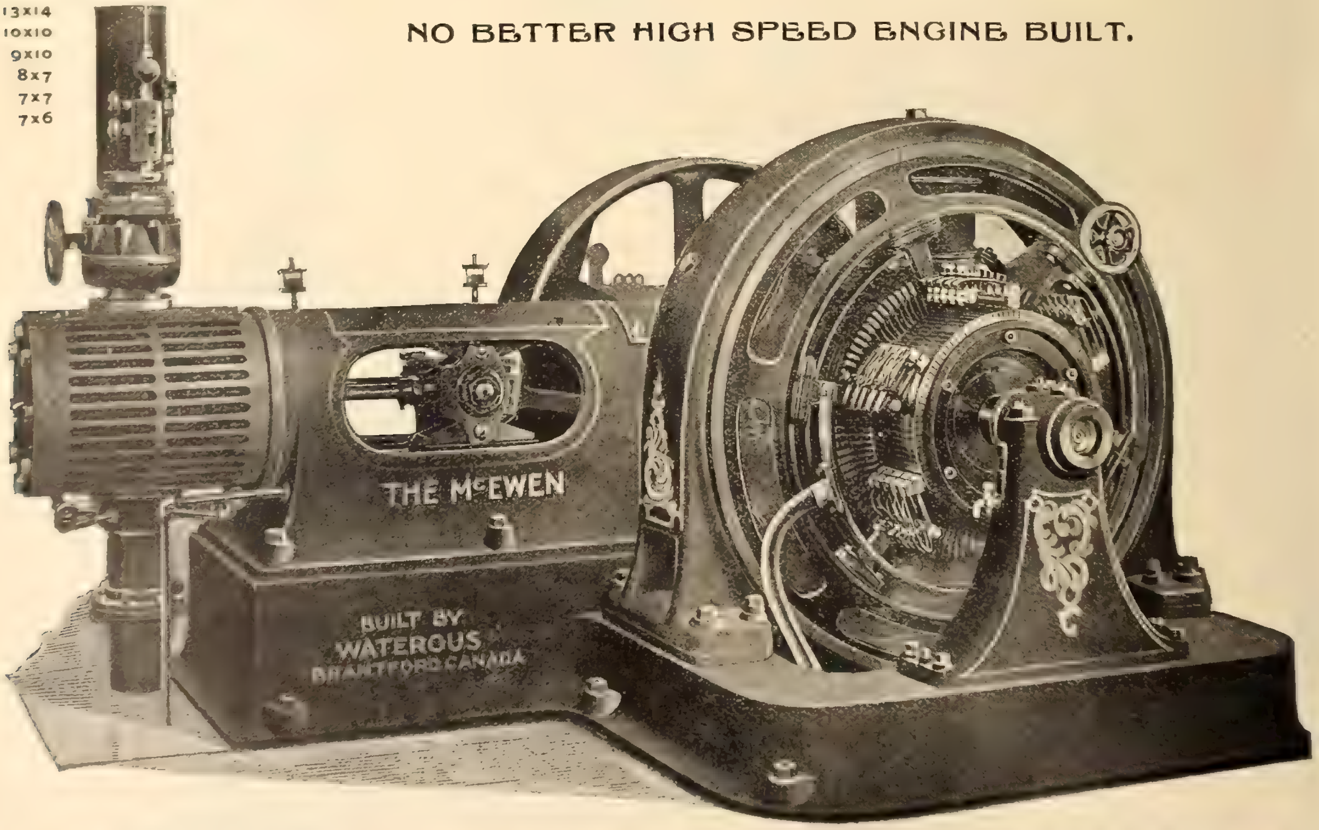

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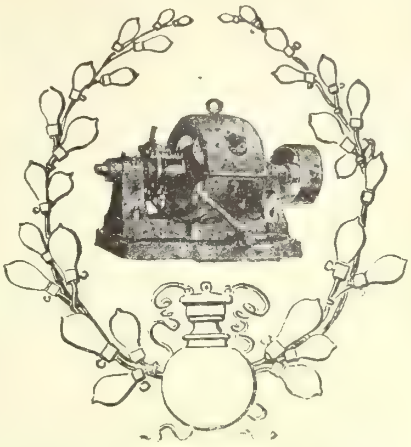

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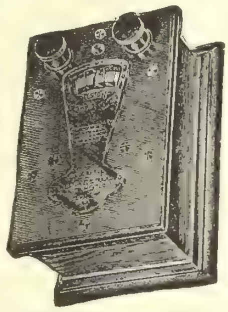

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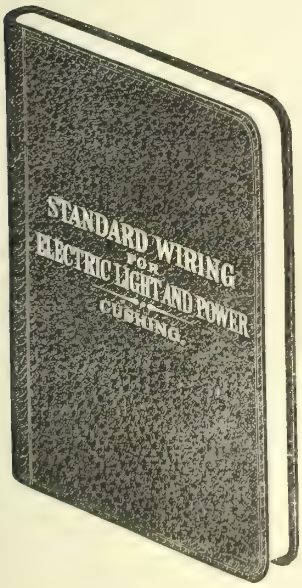
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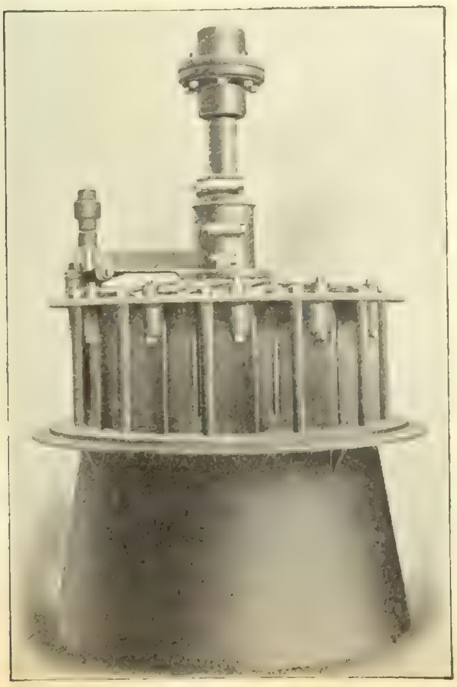

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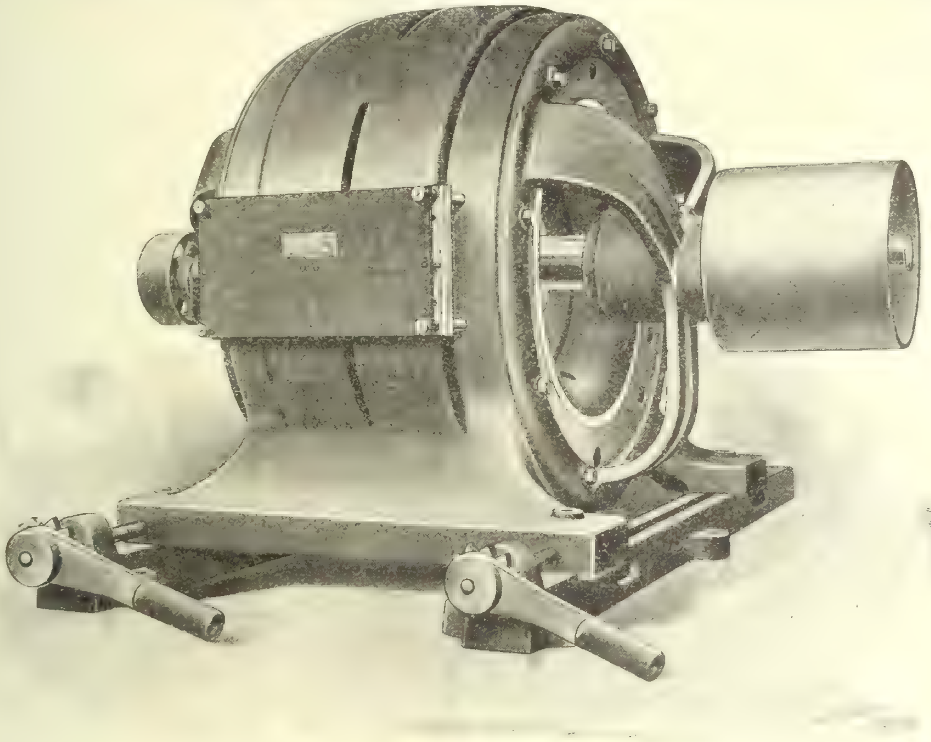

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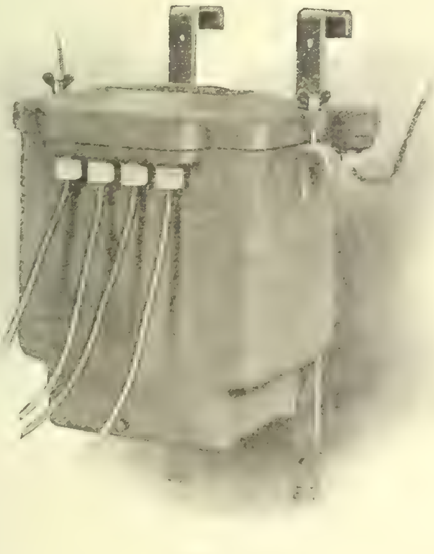
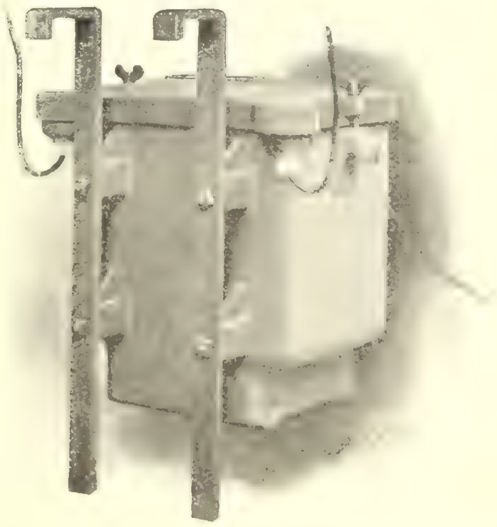


Front View.

OIL INSULATION



Rear View.

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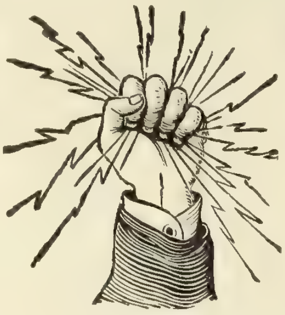

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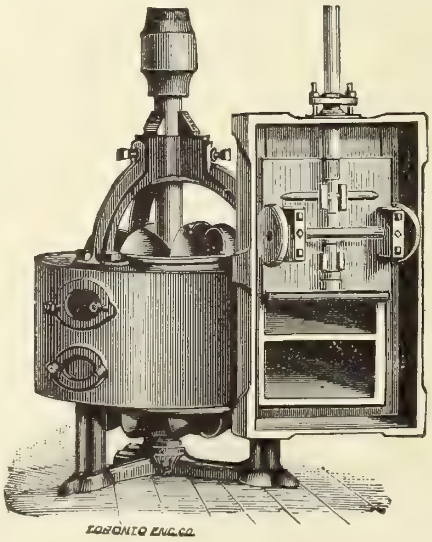
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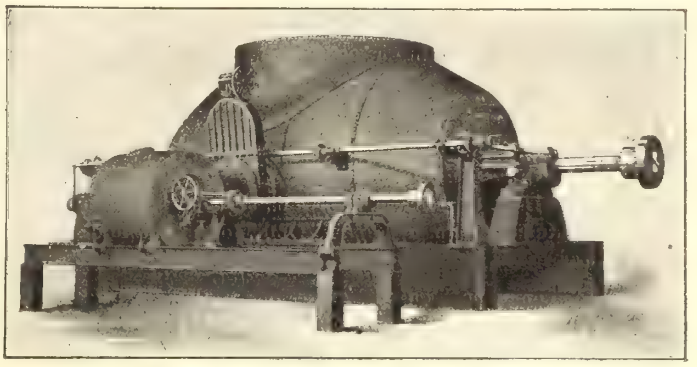

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SPARKS.

Mr. A. F. Donovan has been given a forty years' franchise for installing an electric or gas plant for pubiic service at Athens, Ont.

The Sturgeon Falls Electric Light & Power Company have been given a contract to supply electric light to the village of Cache Bay, Ont.

Messrs. Fogarty Bros., of Montreal, have made a proposition to install an electric light plant at Lanark, Ont., for street and commercial purposes.

Work has been commenced on the extension of the electric railway from Paris to St. George, Ont., and Dr. Ickes, the promoter, states that cars will be running on the line before winter.

The city council of Stratford, Ont., is prepared to enter into negotiations with any company willing to establish an electric railway there. A franchise was granted for this purpose some time ago, but it has now expired.

The offer of Messrs. Moore & Sons to renew the contract for the street lighting of Meaford, Ont., was rejected by the council. Accordingly tenders were invited for a lighting franchise, but at time of writing no award hȧd been made by the council.

Incorporation has been granted to the Sudbury Power Company, Limited, with a capital of $400,000. The head office is at Ottawa, and the provisional directors are A. W. Fraser, H. A. Burbridge, J. G. Turiff, J. G. Gibson and A. A. Fraser, all of Ottawa.

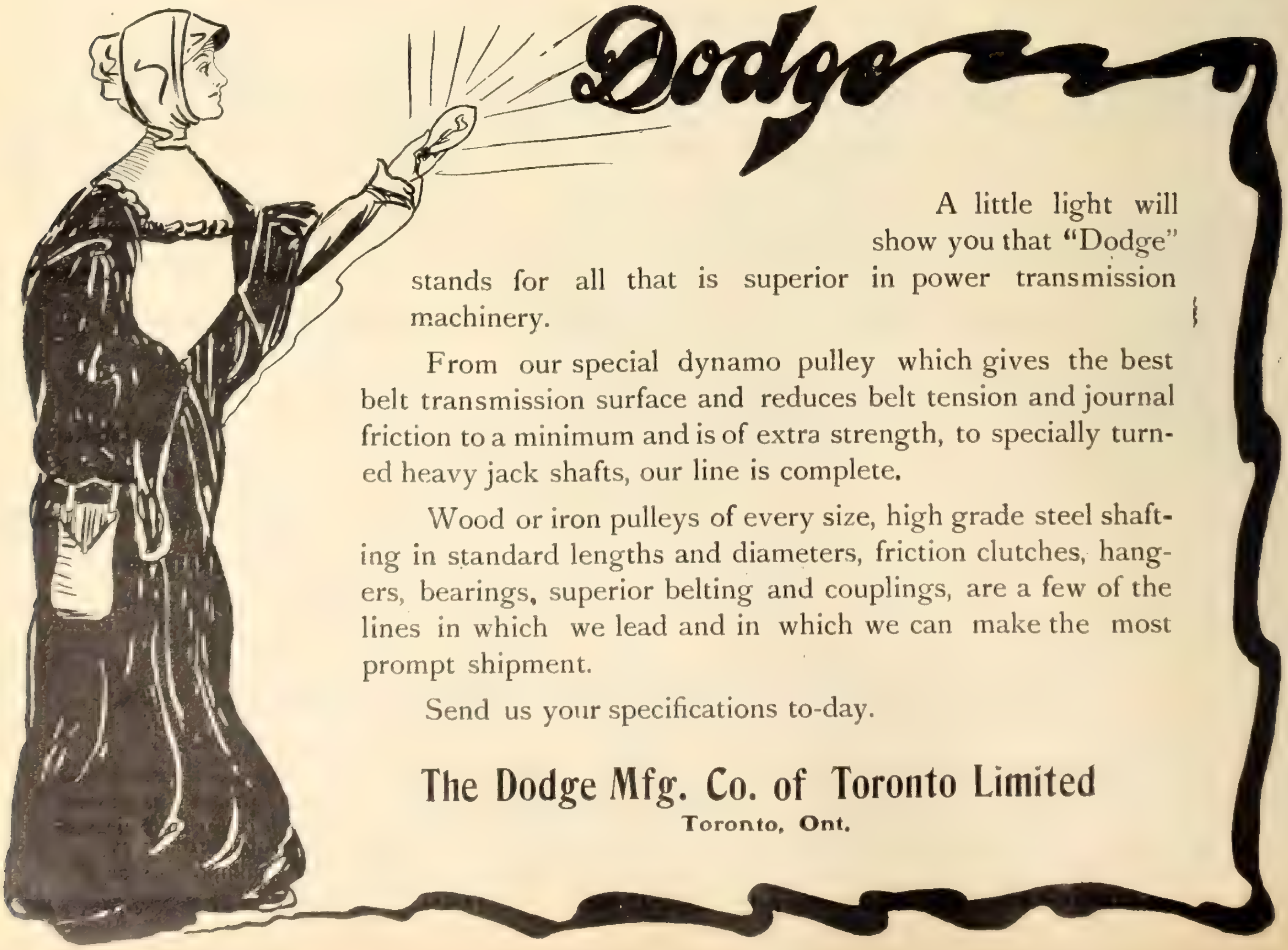
It is stated that the deal between the Southern Traction Company and the English capitalists who are expected to finance the scheme is practically closed. The project includes the construction of a radial electric railway system in the vicinity of London, Ont. Mr. H. M. Rumball, or London, England, is one of the interested parties.

The Great Falls Power Company is the only concern that has submitted a definite offer for the supply of electric power to the city of Winnipeg. They offer to furnish 2,500 horse power at the rate of $50 per horse power per year and agree to deliver at least 10,000 horse power if required within two years.

The Canadain Pacific Telegraph Company have just completed the laying of fortymiles of cable between Bamfield and Alberni, on the west coast of Vancouver Island, B. C. This will give the company an alternate connection between the land and cable lines, and will prevent the possibility of delays through accident.

MOONLIGHT SCHEDULE FOR OCTOBER.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Oct. 2	0 30	Oct. 2	5 15	4 45
3	1 30	3	5 15	3 45
4	2 20	4	5 20	3 00
5	3 20	5	5 20	2 00
6	No Light	6	No Light	.....
7	"	7	"	.....
8	6 00	8	8 30	2 30
9	6 00	9	9 10	3 10
10	6 00	10	10 00	4 00
11	5 50	11	10 45	4 55
12	5 50	12	11 45	5 55
13	5 50	13	0 45	6 55
14	5 50	14	1 50	8 00
15	5 50	16	3 00	9 10
16	5 50	17	4 10	10 20
17	5 50	18	5 20	11 30
18	5 40	19	5 30	11 50
19	5 40	20	5 30	11 50
20	5 40	21	5 30	11 50
21	5 40	22	5 30	11 50
22	5 40	23	5 30	11 50
23	5 40	24	5 30	11 50
24	5 40	25	5 40	12 00
25	5 30	26	5 45	12 15
26	5 30	27	5 45	12 15
27	9 30	28	5 45	8 15
28	10 20	29	5 45	7 25
29	11 15	30	5 45	6 30
31	0 10	31	5 45	5 35
		Total		215 10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From our special dynamo pulley which gives the best belt transmission surface and reduces belt tension and journal friction to a minimum and is of extra strength, to specially turned heavy jack shafts, our line is complete.

Wood or iron pulleys of every size, high grade steel shafting in standard lengths and diameters, friction clutches, hangers, bearings, superior belting and couplings, are a few of the lines in which we lead and in which we can make the most prompt shipment.

Send us your specifications to-day.

The Dodge Mfg. Co. of Toronto Limited
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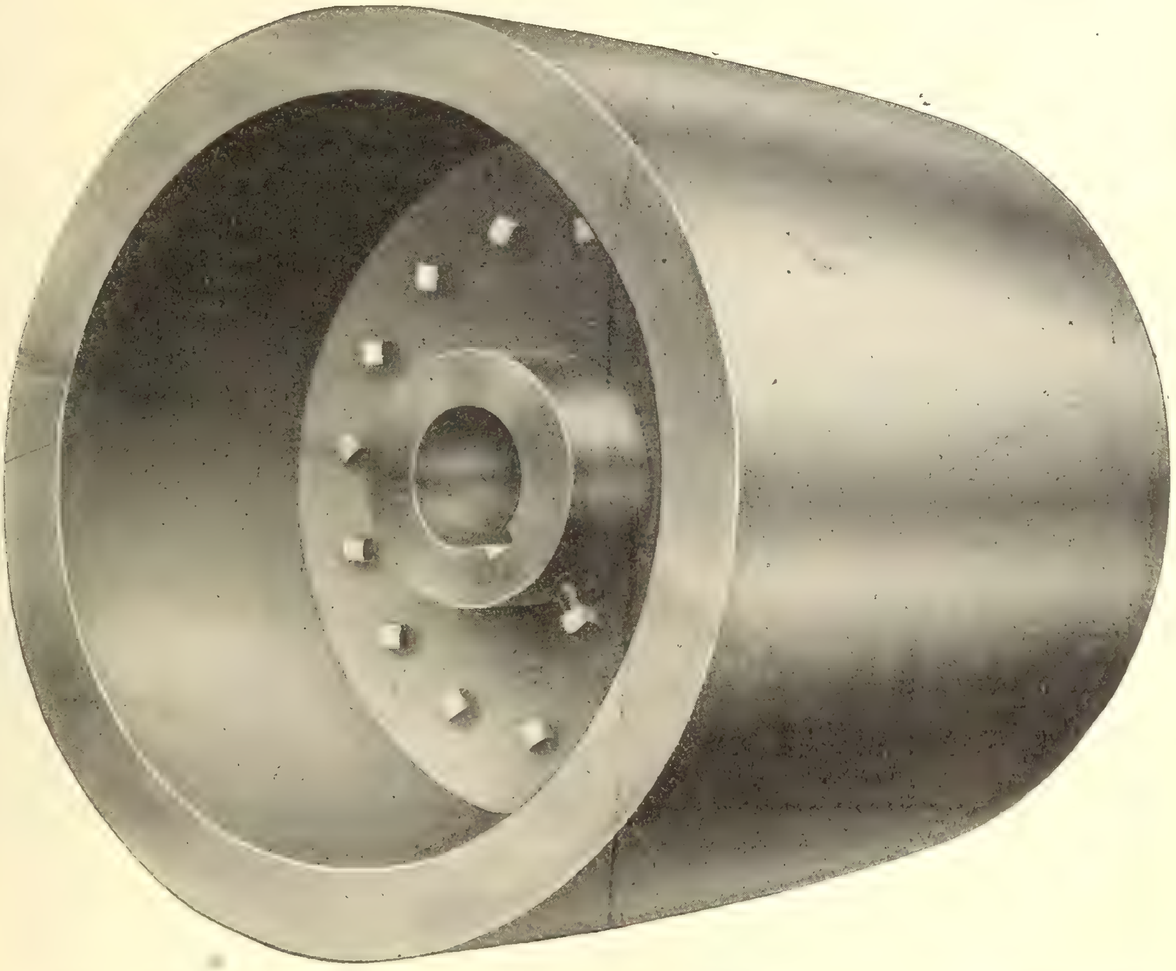

THE ABOVE PHOTOGRAPH WAS TAKEN FROM ONE OF A LOT OF OUR 52½x56x8 XYLOTITE PULLEYS, WHICH WERE THE LARGEST FIBRE PULLEYS EVER MANUFACTURED.

SPECIFY XYLOTITE PULLEYS ON ALL APPARATUS

WE MAKE ALL SIZES. NONE TOO LARGE OR NONE TOO SMALL.

THE XYLOTITE MFG. CO.
CINCINNATI, OHIO

REMOVING SNOW IN MONTREAL.

In 1893 the Montreal Street Railway Co. made a contract with the City of Montreal for the operation of an electric railway. Prior to that time the street cars had been operated by horses and no attempt had been made to remove the snow from the streets, the cars being mounted upon runners during the winter season. In the winter of 1893-4 the company, at the request of the city, did all of the carting necessary to remove the snow from the streets after it had been thrown from the company's tracks, and the city repaid to the company one-half the cost of the work. This system proved to be unsatisfactory and after some negotiation a new contract was made under which the company was to pay a fixed sum per mile of its track and the city was to remove the snow for a term of five years.

When this contract expired the city and the company again discussed the snow question, the city claiming that the company was bound, not only to keep its tracks free from snow and ice but to remove from the street all the snow taken from the tracks, and it undertook to prohibit the company from using electric sweepers and similar appliances in order to bring the company to its terms. The Superior Court and the Court of King's Bench both held against the city, it being held that the company was bound to remove the snow from its tracks only and not from the street and that the restrictions which the city might make under the provisions of the contract with the street railway company related only to the extent of the work to be done and not to the mode of accomplishing it.

The case having been decided against the city by the Court of King's Bench December 27th, 1901, an appeal was taken to the privy council which rendered its decision June 26th, 1903, and dismissed the appeal. The judicial committee of the privy council held that the grant to the city authorized it to operate an electric railway and conferred all rights and privileges necessary for the proper and efficient use of electric power in the "manner successful in this country." Electric sweepers were in successful use in other Canadian cities where the climatic conditions were similar and, therefore, proper to use in Montreal.

Further, inasmuch as the city invites, or at least permits property owners to throw the snow from their roofs and sidewalks into the streets, it is considered that it is quite proper for the street railway to throw snow from its tracks into other portions of the streets without incurring any obligation to remove from the street the snow so taken from the tracks.

PUBLICATIONS.

The Goudey-McLean Company announce the location of their offices at 120 Liberty Street, New York, where they will continue to act as agents for the distribution and sale of electrical apparatus.

The Northern Electrical Manufacturing Company, of Madison, Wis., have just issued Bulletin No. 32 relating to steel crane motors. It contains much information regarding the construction of this type of motor and its adaptability for various purposes.

Direct Connected Generators
For Railway, Lighting and Power

Belt Driven Generators

Multi Voltage System
For Variable Speed Control.

Crane Motors and Controllers

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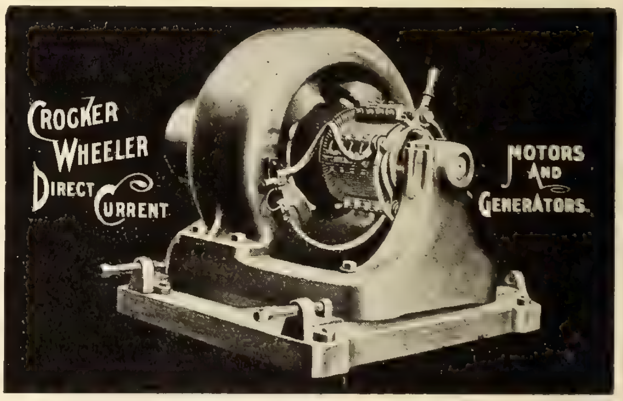

The Pretty Girl calendars are distributed every month. If you don't get these regularly send us your name for our mailing list. At the same time you might as well state when you will need more transformers. Then when you do order, think of Pittsburgh and send your order to us.

Pittsburgh Transformer Company

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Absence of Springs, Chains, Sliding Contacts,
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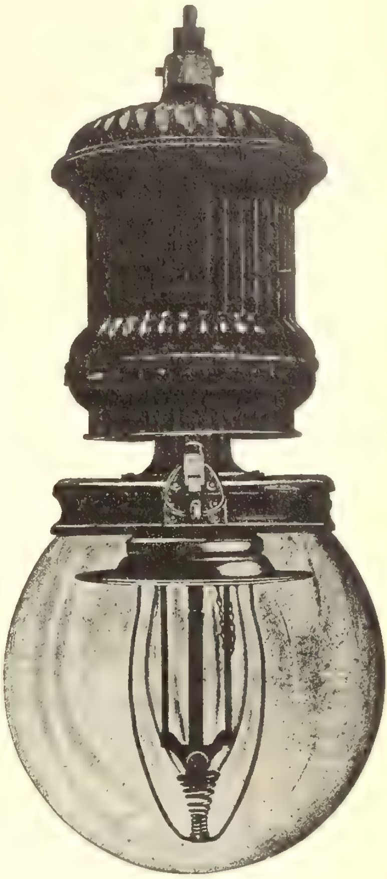

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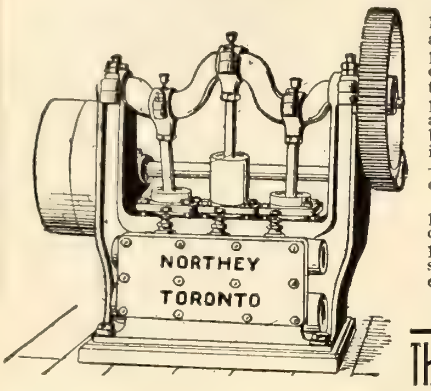

This pump excels in high class materials and workmanship. A practically constant delivery is assured by the three cranks being placed 120 degrees apart. The pump can be operated conveniently by water power—by belt from engine or by electricity.

We manufacture pumps of every description—for all purposes. Our pumps are standard in Canada for excellent service.

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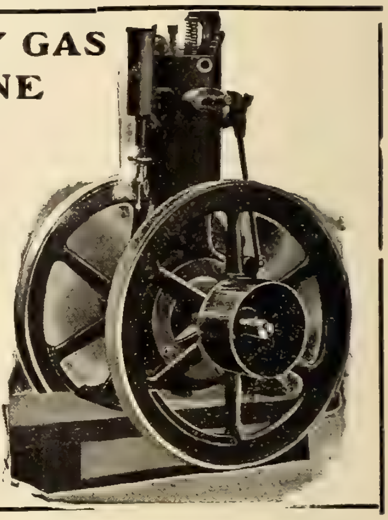
The NORTHEY GAS AND GASOLINE ENGINE

The Northey Gasoline Engine offers the best proposition in the market for cheap, easily handled power. The Engine runs with practically no attention—any boy can manage it—running expenses very light. Ready for work on the minute. Suitable for running independent electric light plants—pumping and elevator plants, etc. This cut illustrates the ½ H. P. size—the only vertical style built; all other sizes are horizontal.

Write for Booklet.



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- Easily trimmed.
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- Steady burner.

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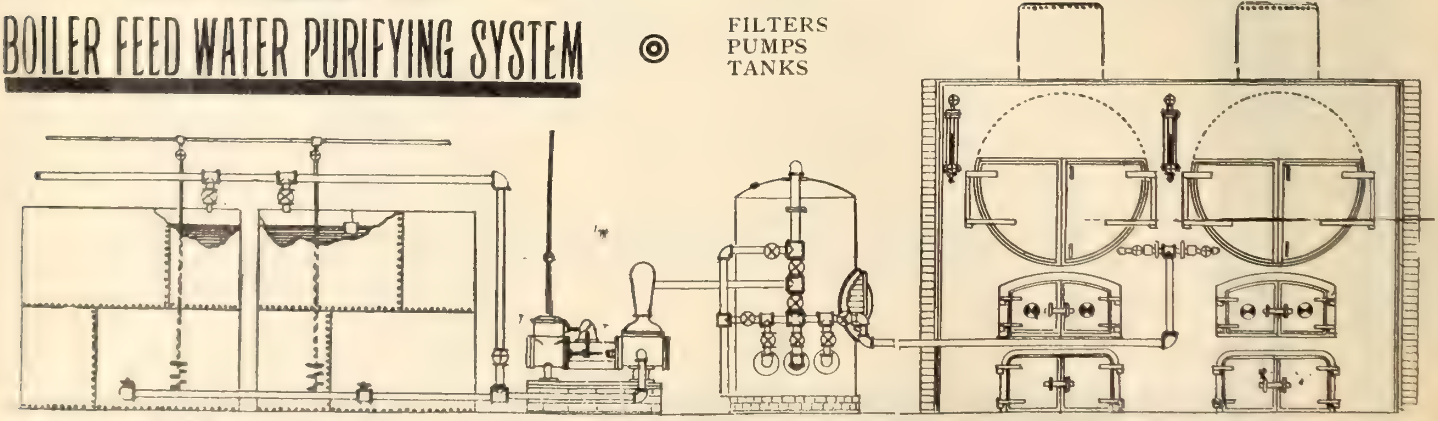


THE JOHN McDOUGALL CALEDONIAN IRON WORKS, LIMITED, - - Montreal, Que.

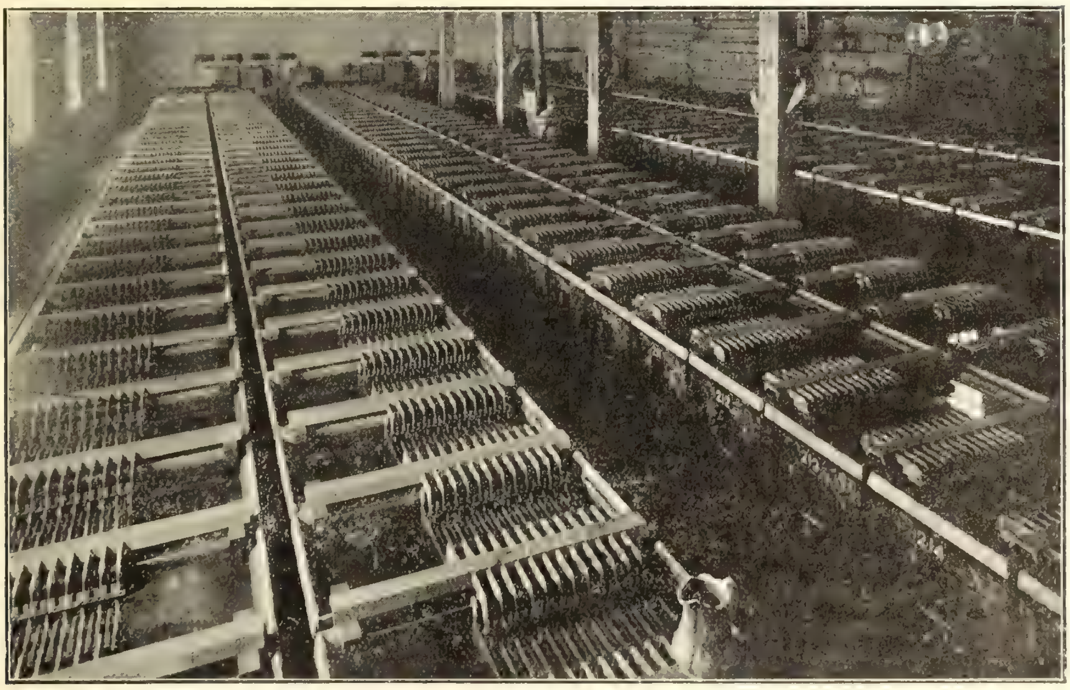
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. SEPTEMBER, 1903 No. 9.

THE POWER PLANT OF THE OTTAWA ELECTRIC RAILWAY.

By John Murphy.

To visit the power house of the Ottawa Electric Railway Company is to be impressed with the conviction that the company's street car system is a model one in every particular. While much could be said about the cheerful, bright and clean cars, the natty and polite employees, and the excellent condition in which the whole equipment is kept, the purpose of this article is merely to describe that part of the system which so quickly excites public interest if it happens to get out of order—namely, the power station.

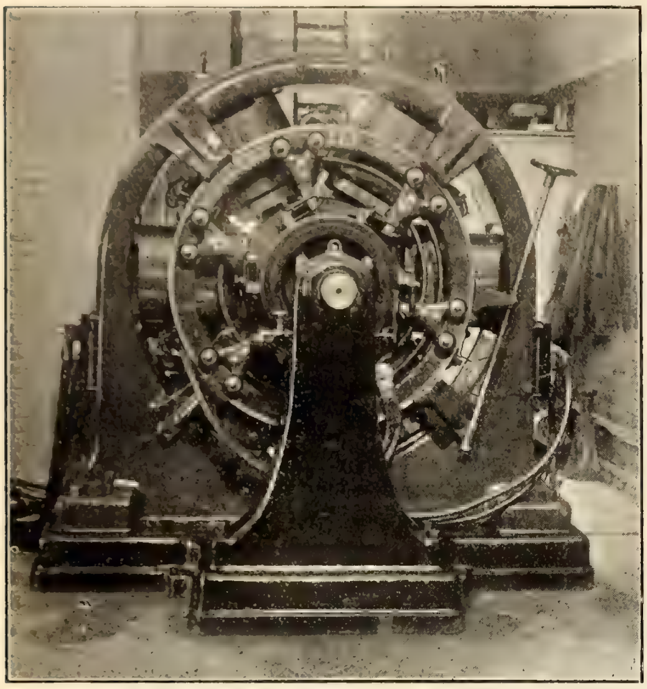


The Ottawa Electric Railway Company—Battery Room in Power House.

Before the memorable fire of April 29th, 1900, which destroyed the greater part of Hull and a large portion of the City of Ottawa, the power plant of the Ottawa Electric Railway Company consisted of two hydro-electric stations containing five Westinghouse generators. Of the latter four were belt-driven four-pole machines, and one was a twelve pole direct-connected machine. The combined output of the belted-driven machines was 2100 h.p., and the output of the other was 2000 h.p. The two stations were situated side by side and either was capable of supplying energy for the whole service. The belt-driven generators were installed in an iron-covered frame building of exceptionally rigid construction and the more modern outfit was contained in a fire-proof brick and steel structure. The latter unit was intended to preclude the possibility of a complete tie-up in the event of an accident to the other plant, as well as to provide for extensions of the service, and while its installation was in progress one of the belt-driven machines, a 700 h.p. generator, was removed to the auxiliary steam station of The Ottawa Electric Company, about a quarter of a mile distant, where it still remains. The fire of April 26th, 1900, completely destroyed the building containing the belt-driven generators, but the new station was practically uninjured. The steam station also escaped destruction, as it occupied a comparatively isolated position.

In the Fall of 1902 a building was erected on the site of the destroyed station, in which there was installed and there is now in operation the largest storage battery in Canada. It consists of 288 cells of the Electric Storage Battery Company's latest improved chloride accumulators. The elements of the battery are contained in lead-lined wooden tanks which have been made large enough to permit of a 50 per cent. increase in the number of plates and in the output of the battery. Each tank now contains twenty-five type G plates, but there is space in each for thirty-nine plates. The tanks rest upon porcelain insulators supported by well seasoned pine stringers suitably waterproofed, and the stringers are separated from the concrete floor of the room by vitrified bricks. This arrangement keeps the battery thoroughly insulated from the ground.

The maximum discharging and charging rates of the battery are 1000 amperes and 350 amperes respectively. As the battery is thus able to take care of load changes amounting to 1350 amperes, and as the Ottawa Electric Railway's fluctuations in load are much less than this amount, the generator load is an absolutely constant quantity.

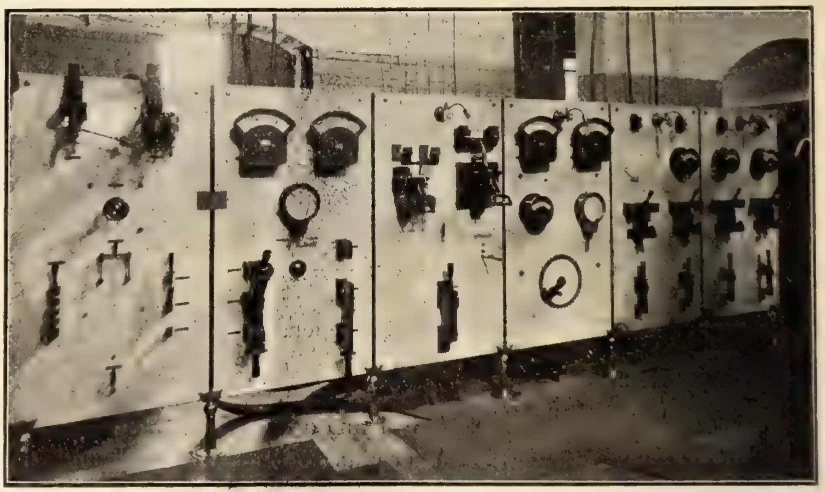


THE OTTAWA ELECTRIC COMPANY — MOTOR-DRIVEN BOOSTER.

It was only after a thorough canvas of the situation that the Ottawa Electric Railway Company decided to install the battery. The company foresaw that in the event of an accident to a water wheel, to a gate, or to the gate-moving mechanism on their direct-connected unit their entire car service would be dependent upon the services of the 700 h.p. steam-driven generator, and to avoid such a contingency additional power plant became a necessity. However, before reaching a decision the question to be solved was this: Which installation would give the best results—a steam-driven generator, a water-driven generator, or a storage battery? The steam plant's first cost and expensive operation were serious barriers to its installation, and the hydro-electric equipment's inability to render assistance at times when it would be most needed, namely, during ice or low water troubles, had much to do with preventing its selection. In the end the battery was decided upon because it would immediately improve the service by maintaining constant e.m.f. at the power house, irrespective of load changes, and for the further reason that it would prolong the life of the hydraulic outfit not only by relieving the water wheels and gates from the jars occasioned by sudden variations in load, but also by saving the gate mechanism from being destroyed through its constant moving back and forth. A further and very important factor in determining the selection of the battery was that it would also act as additional plant. As is well known, street railway loads are of a fluctuating character, and peak hours exist. Thus it happens that between midnight and morning battery charging can always be done and power thus stored during the night can be reserved for times of need. In connection with the generator at the steam station the battery is also able to take care of a respectable limited service.

The beneficial results obtained from the Ottawa Electric Railway Company's battery during the past seven months are so apparent that the management have good cause to congratulate themselves on the wisdom of their choice. Up to the time the battery was installed the water wheel speed and consequent generator e.m.f. was controlled by hand. The controller's efforts met with the degree of success which is illustrated by the recording voltmeter chart No. I. The 550 volt line was aimed at on this chart, but an average of about 520 volts was obtained, while sudden voltage jumps of twenty per cent. were not uncommon. Cars at distant points received about one-half normal voltage when the power house voltage dropped, because the consequent rise in current which accompanied the fall in voltage introduced abnormal line losses—the process being a cumulative one.

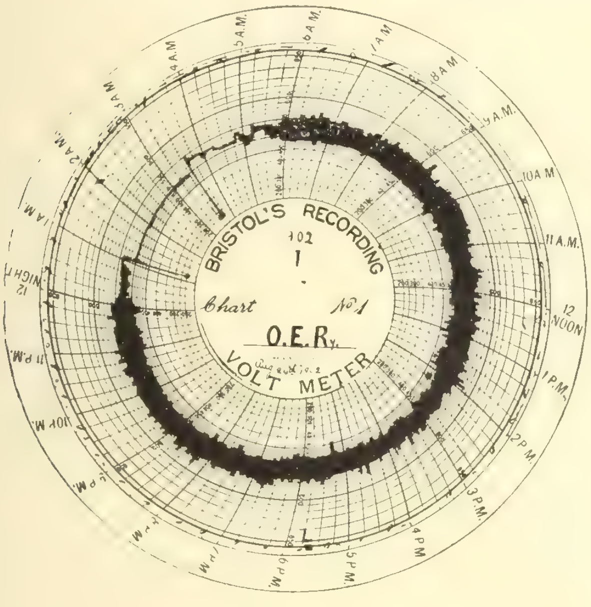
A glance at chart No. II will serve to indicate what the battery daily accomplishes in the way of regulating the bus-bar voltage and generator speed. In fact, a comparison of charts I and II is one of the greatest object lessons ever published. Chart I was made before the battery was installed, chart II afterwards. Chart I illustrates wide speed and voltage variations which occurred despite the constant efforts of faithful attendants to prevent them. Chart II shows what is now done automatically and without the slightest waste of energy in its accomplishment. Both charts were made by the same voltmeter connected across the power house bus-bars. Many lighting plants are operated to-day whose voltage curves would not favorably compare with the Ottawa Electric Railway Company's chart No. II.



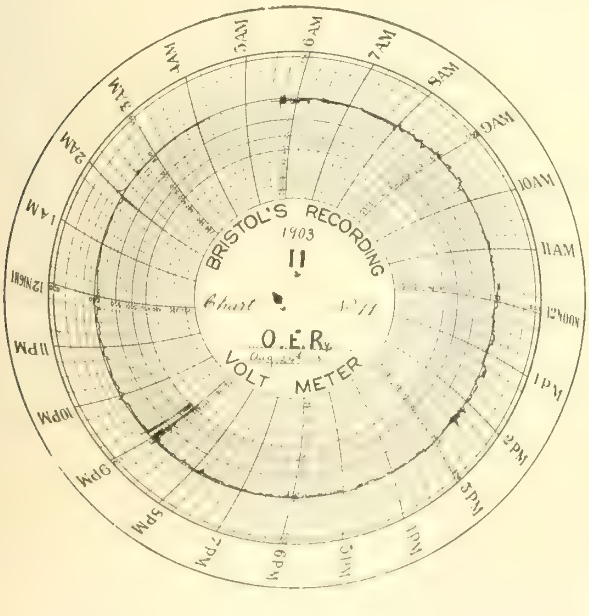
THE OTTAWA ELECTRIC RAILWAY COMPANY—SWITCHBOARD.

The potential and current curves taken down from Weston instruments by two attendants whose actions were kept in synchronism by the bell on a metronome also present a striking illustration of the former and present operating conditions of the plant in question.

It will be noticed that the normal power house pressure is now 600 volts. The generator's speed and its field charge were both increased slightly to obtain this pressure. The pressure was raised to 600 volts for the purpose of obtaining the many benefits available when working at this point and also because it was felt that the battery would hold the pressure constant at whatever point was decided upon. Chart II shows that a variation from the zero point of more than 1½ per cent. is a rare occurrence. The vim with which the cars now ascend grades and the way in which they spring to life when the motorman moves his controller are among the most gratifying improvements that have followed the installation of the battery.



The reduction in the amount of current used per car due to the increased voltage is also a feature worthy of special attention. The power house current output, with the same number of cars in operation, has been reduced 40 per. cent ! The average amount of current used per car, based on power house indications, under old conditions was 28 amperes—it is now 17 amperes. The reduction in line losses on this account is a most important matter, as it will postpone for a long period the necessity of increasing the feeders throughout the system. A differentially wound motor-driven booster works in connection with the battery, and it makes the latter so sensitively active that an absolutely constant load is kept on the generator. The water wheel gates are not moved at all for the purpose of speed regulation ! The gates are opened far enough to make the generator carry the average load and the closest inspection of the tachometer fails to reveal any speed variation. A visitor could easily be persuaded that the generator was supplying an incandescent lighting service, so smoothly does it operate. An inspection of the line and battery ammeters, however, indicates that large and rapid changes are always taking place.



The present plant, consisting of direct-connected generator and battery, is capable of supplying energy to a much greater number of cars than are ever used in Ottawa, and with the steam station a large amount of reserve power is always available. The illustrations represent the booster, the switchboard and the battery room. It is interesting to note, in the switchboard picture, that while the battery and bus voltmeter needles are reproduced quite clearly the ammeter needles are not printed at all—the latter do not remain in one position long enough to be photographed.

MR. JAMES FERNS.

Mr. James Ferns, who succeeds the late Mr. F. H. Badger as Superintendent of the Montreal Fire Alarm Department, was born in Montreal, March 10th, 1854. After a successful commercial course, he entered the service of the Fire Alarm Department in June, 1866. His first study was to master operating, in which he became remarkably expert, being able to use either the Morse or Bain alphabets with equal facility, the Bain at that time being generally used in fire alarm offices. Under the instruction of the late superintendent every opportunity was afforded for intricate testing, and Mr. Ferns soon became proficient in matters electrical. Practically for the last five years he has had charge of the fire alarm system, and many of his inventions are now giving the greatest satisfaction in the fire alarm office. He also made practical the first invention for unhitching horses in fire stations by electricity.

Mr. James Ferns,
Superintendent Montreal Fire Alarm Department.

Since his appointment as superintendent the system is undergoing extensive improvement and alteration. It is his intention to visit the leading United States cities this fall, looking for ideas for further improvements. We wish him every success in his new position.

ELECTRIC POWER FOR TORONTO.

Last spring Mr. C. H. Rust, City Engineer of Toronto, was requested to report to the city council as to the estimated cost of developing electric power at Niagara Falls and transmitting it to and distributing it within the city. Accordingly, he engaged Mr. R. J. Parke, E.E., to prepare a report on the cost of distribution within the city, and also consulted Mr. Alex. Dow, manager of the Edison Illuminating Company, Detroit, regarding the matter. The reports of these gentlemen, which are printed in part below, are of interest to electrical men as well as to the citizens of Toronto. It was not considered necessary to go more in detail into the question than has been done. The curves accompanying Mr. Parke's report were worked out on the basis of the report. Curves 1 to 5 inclusive, not shown, are curves of the various sub-station service loads for December.

REPORT OF R. J. PARKE.

Acting on your instructions which I received on February 28th ast, I have made a careful survey of the city in order to ascertain the amount of power required for electric lighting and motive power services throughout the city. I submit herewith an estimate of the amount of power, the capital cost of a municipal plant for the purpose of distributing the said power throughout the city, and an estimate of the annual cost of operating such a plant.

This estimate is arranged into three main divisions, namely :

Estimate of power for various public services.

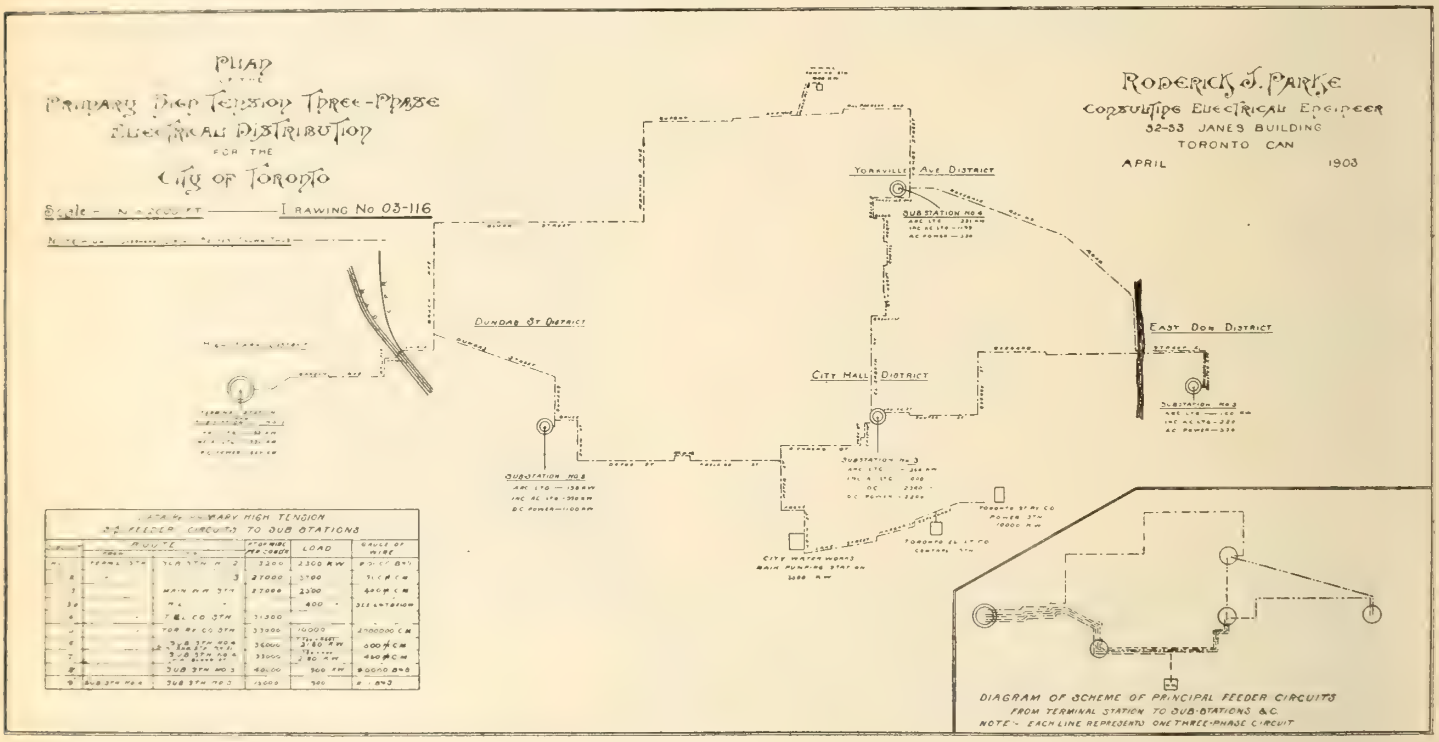
Capital cost of distribution plant.

Operating expenses of the above-mentioned plant.

For the purpose of this estimate, I assume that power will be delivered at some suitably convenient point on the western city limits, by transmission line delivering 3-phase alternating current at from 30,000 to 60,000 volts E.M.F., and 60 cycles frequency. I have chosen for this point a location in High Park near the junction of Garden avenue and Indian road. This location would be the site of the main receiving station hereinafter referred to as the terminal station. From the terminal station power will be distributed by means of 3-phase alternating current over-head circuits, of suitable voltage, to the various sub-stations throughout the city, all as shown on drawing No. 03-116 herewith.

ESTIMATE OF POWER REQUIRED.

The amount of power required for each of the respective services given below, is as follows :


PLAN OF THE
PRIMARY HIGH TENSION THREE-PHASE
ELECTRICAL DISTRIBUTION
FOR THE
CITY OF TORONTO
DRAWING No 03-116
RODERICK J. PARKE
CONSULTING ELECTRICAL ENGINEER
52-53 JANES BUILDING
TORONTO CAN
APRIL 1903
YORKVILLE AVE DISTRICT
SUB STATION NO 4
DUNDAS ST DISTRICT
EAST DON DISTRICT
CITY HALL DISTRICT
SUBSTATION NO 5
SUBSTATION NO 2
SUBSTATION NO 3
TORONTO ST RY CO POWER STN 10000 KW
TORONTO EL LT CO CENTRAL STN
CITY WATER WORKS MAIN PUMPING STATION 2500 KW
DATA OF PRIMARY HIGH TENSION FEEDER CIRCUITS TO SUB STATIONS
ROUTE
LOAD
GAUGE OF WIRE
DIAGRAM OF SCHEME OF PRINCIPAL FEEDER CIRCUITS FROM TERMINAL STATION TO SUB-STATIONS &C
NOTE - EACH LINE REPRESENTS ONE THREE-PHASE CIRCUIT

Street lighting	950	K.W.
Incandescent alternating current lighting	2,500	K.W.
Incandescent direct current lighting	2,400	K.W.
Alternating current motive power	1,700	K.W.
Direct current motive power	3,300	K.W.
Main W.W. pumping station power	2,500	K.W.
H.L. W.W. pumping station power	400	K.W.
Total	13,750	K.W.

The above total does not represent the load at the terminal station because the maximum loads in certain districts are thrown upon the terminal station at a time when other loads are on a decline, consequently the load which would likely be thrown on the terminal station by all the services would not likely exceed 10,000 k. w., which would be about the amount of power to be charged for at this point by the producers.

To the above, however, should be added the estimated load of the Toronto Street Railway, which would be approximately 10,000 k. w., making the entire load upon the sub-station equal to 20,000 k. w. as a maximum.

CAPITAL COST.

STATION EQUIPMENTS :

Terminal station, high voltage side	$230,000.00
Terminal station No. 1, sub-station side	20,400.00
No. 2 sub-station	101,000.00
No. 3 sub-station	160,000.00
No. 4 sub-station	35,100.00
No. 5 sub-station	19,500.00
Total	$566,000.00

Buildings	$ 70,000.00
Underground distribution system	566,559.00
Overhead distribution system	483,082.00
Engineering, supervision and contingencies	100,000.00
Total cost	$1,785,641.00

OPERATING EXPENSES.

FIXED CHARGES :

Interest on Bonds at 3.75 per cent	$ 66,961.00
Sinking and Depreciation Fund at 7%	124,994.00

VARIABLE CHARGES :

Operating staff	62,000.00
Repairs, supplies, etc., chargeable to maintenance	30,000.00
Total annual expenses	$283,955.00

If the current be delivered at 30 cycles or 25 cycles instead of 60 cycles the sum of approximately $150,000 will have to be added to the above estimate for apparatus for raising the frequency to 60 cycles in order to operate incandescent alternating current lighting and the street lighting system.

The above estimates can be reduced by about 25 per cent. if a plant suitable for only immediate requirements be contemplated.

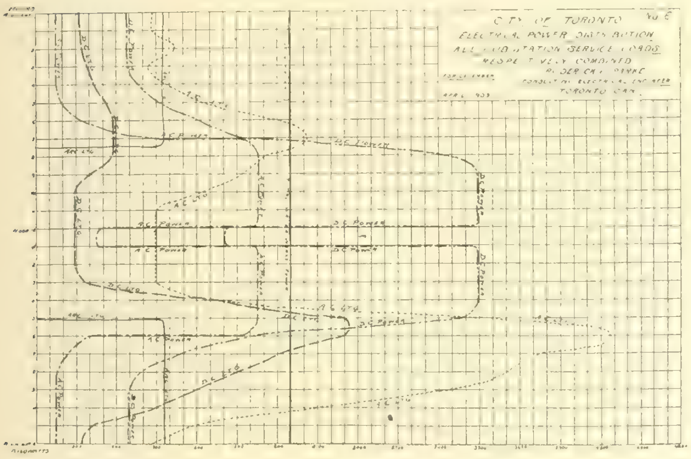
The above estimate covers the capital cost of a plant suitable for the probable requirements of the next five years.

REPORT OF ALEX. DOW.

The following figures are based on the premises as set forth in Mr. R. J. Parke's report of May 1st, namely, that a maximum of 10,000 kilowatts capacity at the city limits will permit the connection of different classes of business aggregating 13,750 kilowatts. I think that this assumption by Mr. Parke is justified.

OWNERSHIP OF TRANSMISSION LINE.

A line and right of way such as would be advisable would cost between $700,000 and $1,000,000. The difference is partly the difference in distance between the two powers under consideration, to wit, Jordan and Niagara, and is to some extent a matter of detail of construction depending on factors which are not now before us. The maintenance of such a line, to wit, the constant patrolling required and the making of ordinary repairs, will cost from $10,000 to $12,000 per year. Interest on the investment being assumed at 3.75 per cent. and depreciation and sinking fund assumed at 5 per cent., would give a total annual cost of transmission line of, say $100,000.



It is to be noted, however, that such a line would take care of twice the capacity at which it is now proposed to load it. I do not think it wise to build a line for the exact capacity required. The cost would not be proportionately reduced because the expense for right of way, for poles, cross-arms and fittings would be identical in either case, the only increase being in the amount of copper. It appears to me that under those circumstances the development of the business should be provided for in the first investment in transmission lines. It is to be noted also that if copper is used the metal is always a good asset. I assume also that the right of way will be a good asset.

The figures submitted by the Hamilton & Lake Erie Power Company for power at Jordan and for power at Toronto city limits differ by $10 per horse power of capacity required. This is, however, not a net difference, because the city will require to purchase at a maximum say 15 per cent. more power at Jordan than it would require to purchase at the city limits to make good the loss in transmission. Under the present conditions, therefore, the saving to the city by owning its own transmission line would not be great, but any increase of power sold in Toronto up to the capacity of the line would directly increase the saving. A line such as I have estimated will take care of 20,000 kilowatts. If that load should be attained the city would be saving $130,000 per annum.

I have taken safe figures in making this statement. I may add to it that it strikes me that the Hamilton & Lake Erie Power Company do not want to build that line or they would have made a less difference in the price of power at Jordan and power at the city.

COST PER HORSE POWER AT CITY LIMITS.

Assuming your figure of $10 per horse power at Niagara Falls or at Jordan, there must be added to this 15 per cent. for the energy expended in the transmission line. There must also be added a pro rata of the annual cost of the transmission line; 10,000 kilowatts is equal to 13,400 horse power. As follows :

TABLE NO. 1.

Cost per horse-power generated.	$10.00
15 per cent. transmission loss	1.50
Pro rata of cost of transmission line. . . .	7.46
Total	$18.96

But this is the condition if the entire annual cost of the transmission line is charged to the present business. The transmission line is fit to take care of twice the present business. Assuming that the business has been increased 50 per cent. we have the following :

TABLE NO. 2.

Cost per horse-power generated.	$10.00
15 per cent. transmission loss.	1.50
Pro rata of cost of transmission line. . . .	4.98
Total	$16.48

Mr. Parke estimates that the addition of the business of the Toronto Street Railway Company would double the work on the transmission line. It would be good policy both for the City and the Street Railway Company to combine their demands at least as far as the city limits. The same reasons which warrant the construction of a line having more capacity than the immediate demand would dictate this conclusion. Assume that this business is added and your figures are as follows :

TABLE NO. 3.

Cost per horse-power generated.	$10.00
15 per cent. transmission line.	1.50
Pro rata of cost of transmission line.	3.73
Total	$15.23

If the Street Railway Company should require power it would naturally take delivery of that power at the city limits, and the above figures should be taken as a guide in fixing the price. Even if power should be furnished to the railway company at cost, it is evident that their use of the same transmission line would bring down the average price of power to all consumers.

COST OF POWER DISTRIBUTED.

Because the different demands for power do not coincide in time, Mr. Parke has (I believe correctly) estimated that with a maximum of 10,000 kilowatts (13,400 horse-power) at the city limits, services to a total of 13,750 kilowatt hours (18,425 horse-power) can be provided for. He estimates the total annual expense of distribution (including a high charge for depreciation and sinking fund) at $283,955. There will be certain electrical losses in distribution whereby it will result that more power will be required at the city limits than will be accounted for by the customers' meters or be chargeable to customers under a contract system if meters are not used. Meter slip—that is to say, the amount of energy which customers' meters fail to record—is the largest single item of this loss. The next largest is the conversion loss from alternating to direct current which is necessary to provide for the incandescent direct current lighting and direct current motive power. After careful consideration the total distribution loss can be provided for by adding to the cost of energy received at the city limits 20 per cent.

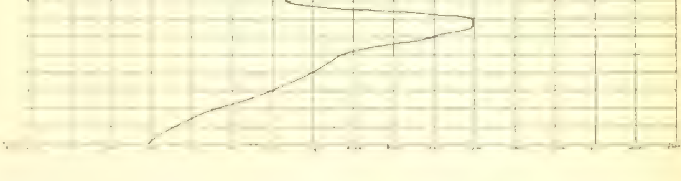


TABLE NO. 4.

Cost per horse-power at city limits, maximum figure :	
Table No. 1	$18.96
Add 20 per cent. for distribution losses. .	3.79
Add expense of distribution per Mr. Parke's estimate.	15.41
Total	$38.16

It results that the city should receive an average figure for power distributed by it sufficiently in excess of $38.16 per h.p. per annum to prevent any possibility of loss.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Switchboards. The appearance and location of the switchboard equipment of the average small plant would lead the casual visitor to believe that this part of the installation was but a minor and unimportant item, whereas if the truth were recognized it would be seen that such is far from being the case. Continuity of service is the one and paramount desideratum of operation, but this cannot be expected unless all parts of the equipment are kept in proper shape. That this is not done is evidenced by the nondescript appearance which the switchboard so often bears, wooden boards, boards with broken switches, open lead fuses, spacings between bare parts which are scarcely fit for 200 volts, let alone 2000 which is frequently the potential obtaining, boards with neither lightning arresters nor ground detectors—the list might be extended almost indefinitely. Then again, the matter is frequently made worse by crowding the equipment, good bad or indifferent, into a corner containing barely half the necessary room and giving every chance for the accumulation of station refuse and every excuse for the want of attention on the part of the attendant. Good reliable switchboards, equipped with tried and proven devices, are now standardized by all manufacturers and thus can be quoted at prices considerably below those prevailing a few years ago. Surely it will pay any and all plants to see that this part of their equipment is strictly up to date, especially when the expenditure can be looked at as one form of insurance against not only interruptions to the service, but also a possible total destruction of the plant.

Multiphase Transformers. The European manufacturers of electrical apparatus have for many years advocated and sold multiphase transformers, but the practice on this side has always inclined to the use of single phase apparatus. Just as the copper of three single phase transmission lines can be amalgamated to form one single three phase line of increased capacity, so the iron and copper of three separate transformers, if made into a multiphase equipment, can be used to produce a considerably larger output. It is therefore peculiarly interesting to see that the General Electric Company, who have for long been one of the principal upholders of single phase transformers, are now publicly advocating three phase and six phase equipments, and thus are adopting the ideas of Continental engineers. The converse of increased output by combining three single phase transformers into one three phase is of course the production of a given output more cheaply by the use of three phase than of single phase equipments. This means that one transformer, containing in its case the necessary cores and windings for a three phase or six phase circuit, would cost less and weigh less than three single phase equipments. Further than this, it has other advantages which may perhaps be of even greater weight, namely, greater ease in handling and installing, especially on poles, improved appearance, decreased floor or pole space and also less complication in the wiring required. It will at once be recognised that this is a large list of strong points, and now that one of the largest manufacturers on this continent has commenced to quote on the type, it is to be expected that the example will be followed by many other producers and that consequently installations of this class of apparatus will become as common in the future as they have been infrequent in the past.

Wiring Methods and Material.

We have previously had occasion to call attention to the crying need for improvement in the way in which electrical machinery and wiring is often installed, but the frequency with which cases of criminally careless work come to light, let alone those which at the best are but botchwork, would seem to indicate that the matter is in many cases being entirely lost sight of. As an example we would cite an installation which recently came under our notice in which a 2200 volt line was carried into the basement of a building, no lighter and no dryer than basements usually are, with ordinary weatherproof wire, run on knobs. At several points it had been necessary to insert connectors, parts of which extended to within two or three inches of each other and were not even taped over, notwithstanding that they were within easy reach of anybody passing, being but four or five feet from the floor. Further than this, ordinary lead composition fuse wire, bare, was in use. Compare the above with a proper equipment of rubber wire and enclosed fuses, the former run in conduit and the latter with their necessary connectors and mountings boxed in cabinets, and you will have some idea of its shortcomings. At another installation, a woollen mill, with its usual contents of highly inflammable material occupying all parts of the building, to say nothing of the lint and dust which invariably accompany such processes, there was found the old familiar open lead fuse, some in cutouts with porcelain covers and some without even this slight protection. This meant that the blowing of one of them was almost cerain to ignite the pile of material immediately below it, with ultimate results which can easily be imagined. Proper enclosed fuses, installed in cabinets, would have cost but a trifle more and would have made a fire of electrical origin a remote possibility, instead of a large probability. Is it any wonder that when work such as found in the above instances is allowed to be put in, that the uninformed public, and for that matter, many who claim to be well posted, look askance at the proposal to introduce electric power. In the former of these cases the installation was a positive menace to life, and both offered every chance for a severe fire, the reports of which, spread far and wide the country over, would contain but one theme, the great fire risk from all electric wires and machinery.

Converting Alternating Into Direct Current.

The comparative simplicity with which an alternating current of any given pressure can be changed to any other desired potential gives this form of electric distribution great advantages over direct current systems, but it is frequently found that the latter is absolutely necessary for some of the processes involved, such as electro-chemical work, election traction, or for the charging of storage batteries. This has naturally made a demand for some form of apparatus which will change the one into the other, several types of which have consequently been developed. Perhaps the earliest device and the most widely used, consists of the familiar motor-generator set, composed of an alternating motor, either synchronous or induction, driving a direct current generator. Compared with all the other methods of accomplishing the desired result this has the great advantage of giving a wide range in the direct current voltage, in addition to which the latter circuit is entirely separate from the alternating supply. The main shortcoming is that both the motor and generator have each to be of a kilowatt capacity equal to that of the output, which means greater cost and somewhat less efficiency, seeing that there are losses in two machines instead of one. The result of the effort to overcome these defects was the rotary converter, a machine, always of the revolving armature type, provided with both a commutator and a set of collector rings, which takes the alternating current in at one end and gives it out as direct at the other. This means smaller and therefore less costly machinery, of higher efficiency, but the two circuits are not insulated from each other, nor is there much opportunity to vary the direct current voltage, as it bears a certain ratio to the alternating potential supplied, which ratio is fixed by the design of the apparatus. Futher than this, in almost all cases static transformers have to be supplied to give the required alternating potential.

A device of radically different design from either of the foregoing is the Leblanc rectifier, which consists of a rotating commutator actuated by a small motor. This latter is driven by the alternating current to be rectified and as a consequence the speed of the commutator keeps in step or synchronism with each half wave, reversing it just at the proper instant and thus producing a direct current. The apparatus is quite efficient, there being practically no losses other than those due to friction, but so far its development has been hindered by the heavy sparking which appears to be insurmountable. The converse of the Leblanc rectifier, in which the commutator revolves, is the stationary commutator supplied from a ring wound coil, which is energized from a multiphase circuit, and thus contains a rotating magnetic field. A set of rotating brushes bear on the commutator and collect direct current from it.

Still another style is the electrolytic. A cell of platinum and iron, for instance, will pass a current in one direction only, opposing the other half of the wave. By a suitable combination of cells both halves can be utilized to form a direct current. To the same class belongs the recent discovery of Mr. Hewitt, who utilizes mercury vapor as the conducting medium, instead of the iron-platinum cell. It is not yet definitely known just what his apparatus is capable of doing, but so far the indications are that it has a very large field in front of it, being highly efficient and at the same time much less costly than the other types.

While a 300 horse power Wheelock engine was being installed in the municipal electric light station at Midland, Ont., Henry Chester was caught between one of the blocks and the engine and his leg broken. Another workman, Samuel Warner, called for assistance for Chester, and immediately after doing so expired himself, death probably being due to heart failure caused by the shock.

Dr. Haanel, Superintendent of Mines, Ottawa, was one of a Government Commission which recently investigated a process for the treatment of magnetic iron ores by electric smelting, the invention of Prof. Ruthenberg. Specimens of product taken during a trial run at Lockport, N. Y., are now in the hands of the assayer, and a report will shortly be made to the Minister of the Interior.

EXHIBITS IN MACHINERY HALL AT TORONTO EXHIBITION.

"Better than past years" is the almost unanimous verdict of persons who have inspected the exhibits in the Machinery Hall at the Toronto Exhibition now in progress. This year there are several new exhibitors, while one or two who were represented last year are missing. There is general complaint that the accommodation provided by the building is inadequate, which may account for the fact that some of the largest Canadian manufacturers do not exhibit.

The largest exhibitor in the Hall is the Canada Foundry Company, who occupy a space 12 x 128 feet on the south side of the building. There are shown three centrifugal pumps in operation, each discharging about 200 gallons per minute. A full line of boiler feed pumps, a large sinking pump for mining purposes, and outside pack plungers complete the display in this department. Their gasoline engines are shown in a range from 1½ to 7 horse power. A feature of the exhibit is the Curtis electric truck, one of a large order for the Toronto Railway Company, and we understand that they have just completed a large order for the Winnipeg Street Railway. The truck is a swing motor truck, the bolster being carried on full elliptical springs. The truck frame is supported by four coil springs at each pedestal. A full line of water pipes, valves, hydrants, drinking fountains and ornamental iron work, including a large gate said to be the heaviest grille work ever made in Canada, complete the display, which is lighted in a brilliant manner by the Canadian General Electric Company's latest type of multiple alternating current arc lamps. The exhibit is in charge of Mr. H. O. Edwards.

The United Electric Company, Toronto, exhibit a 40 k. w. 250 volt dynamo, a duplicate of the machine installed in the Toronto City Hall, a 30 k.w. multipolar 250 volt machine operated by a Bell engine, two bipolar machines, one 25 and the other 15 k.w., 125 volts, a 75 k.w. "Superior type" induction alternator, a 25 h. p. induction motor, and several bipolar and and multipolar motors, together with complete switchboard equipment, including Whitney instruments and standard high tension switches. As a special feature they show a switchboard for an engine room of a steam yacht. It is fitted with seven distribution switches, two 3-pole main switches, Ward-Leonard Electric Company rheostats and Whitney instruments, all mounted on Tennessee marble. The board is 4 feet by 2½ feet and of high-class finish.

In the space occupied by the Jones & Moore Electric Company, Toronto, is found a Goldie & McCulloch "Ideal" engine operating one 40 h. p. and one 75 h. p., 125-volt generators, and a line of multipolar and bipolar machines connected up. They supply arc and incandescent lighting throughout the Machinery Hall. Their switchboards are equipped with quick-break switches, which prove very effective. Arc lamps for alternating current, 110 volts, and for series, are shown, also telephone instruments and electric fans. One of their ¼ h. p. motors operates the exhibit of the Henderson Roller Bearing Company with comparative ease.

Among the many attractive exhibits is that of the Rogers Electric Company, Toronto, who show electric and combination fixtures, electric fans, telephones, switches and electrical supplies generally. Their Japanese art domes for electric lights are unique, a particularly pretty one being of Pompeiian green in tiffany finish, the trade price being $250.

The Toronto & Hamilton Electric Company, of Hamilton, are again conspicuous by a display of generators and polyphase and induction motors, switchboards, arc lamps, etc. They have recently placed on the market a line of polyphase motors of two and three phases which are meeting with a large demand.

"King Edward" dynamos and motors are exhibited by the Consolidated Electric Company, Toronto. A 25 h. p. dynamo is supplying current for only one lamp, but notwithstanding such an unfavorable condition there is apparently little or no waste of current.

The exhibit of the Goldie & McCulloch Company, Galt, is this year larger than usual. One of their "Ideal" engines of 90 h. p. drives a line of shafting on the south side of the building, and a 100 h. p. Wheelock engine drives the shafting on the north side. They show several wood and iron working machines, including a railway cut-off saw, No. 18 planer, No. 9 planer and No. 0 moulder, also gyrators and Philbrick patent matcher heads.

Mr. William Bennett, of Sunderland, Ont., has in operation a one-cylinder engine, claimed to be the only engine of this type in successful operation in the world. The steam is compounded in high pressure temperature, high and low pressure steam being used in one and the same cylinder continuously and alternately.

Babcock & Wilcox, Limited, Montreal and Toronto, are new exhibitors this year, and they have the honor of showing the only boiler in the building. It is one of their well-known water tube type, of 20 h. p. and carrying 130 pounds of steam. They have just installed two boilers of 500 horse power for the Toronto Street Railway, and two more are on order for installation early this fall. They have also secured the contract for 750 horse power for the King Edward Hotel in this city. The Toronto office of the company is at 114 King Street west, in charge of Mr. A. C. Larkin.

Power transmission machinery and shafting are exhibited by the Dodge Manufacturing Company, Toronto. They show a rope drive driving down to a jack shaft with friction clutch attached, automatic friction winches, wood-split pulleys, iron centre wood rim pulleys, bearings, hangers, etc., and a railing of steel shafting with clutches and pulleys attached. The business of this company is growing very rapidly, their goods being now in use for almost every conceivable purpose.

The Philip-Carey Manufacturing Company, 100 Front street east, Toronto, make a fine showing of their 85½ per cent. magnesia pipe and boiler covering, which is claimed to have the highest efficiency of any covering on the market. Locomotive lagging, asbestos packing and magnesia flexible roofing cement are included in the line of goods shown.

Many favorable remarks were heard concerning the exhibit of the James Morrison Brass Manufacturing Company, of Toronto. The arrangement is artistic and makes a very striking effect. The goods shown include the well-known "J.M.T." injectors and valves, the Ohio injector, Locomotive monitor injectors, Heintz steam traps, Hancock inspirators, phosphor bronze valves for pulp mills, pop safety valves, steam gauges, repeating steamship telegraph gongs, gong bells and oil cups, together with a large and varied assortment of beautiful electric fixtures, the whole "Made in Canada."

The Canada Metal Company, Toronto, have a very creditable showing, the goods including a full line of babbitt metals of all grades, wire solder, battery zincs, antimony, phosphor tin, and fuse wire, the company claiming to be the only manufacturers of fuse wire in Canada. The visitor is attracted by a large figure of a man surmounting the stand, made entirely of metal.

A range of gas and gasoline engines from 3 h.p. to 25 h.p. is exhibited by the Goold, Shapley & Muir Company, of Brantford, Ont. One of these engines is fitted with a combination attachment by which it can be changed from gas to gasoline, and vice versa, without stopping the engine.

Engineers' supplies are shown by the Hamilton Manufacturing Company, Toronto. They include metallic high grade engine and pump packings, steam flue blowers designed to prevent waste of steam, "Perfect" oil filters and "Neverslip" pulley coverings.

Mineral wool in its crude form and after being manufactured is shown by the Eureka Mineral Wool Company, of Toronto. Mineral wool is made by converting scoria and certain rocks while in a melted condition to a fibrous state. It is also made from blast furnace slag, the molten slag being blown into a fibrous condition by the action of steam and hot air. As a boiler and pipe covering it is claimed to give excellent results.

Boiler covering also forms the feature of the exhibit of the Mica Boiler Covering Company, of Toronto. This covering is manufactured in two classes, one for boiler and cylinder covering and the other for steam and hot and cold water pipes.

Several pyramids of oak-tanned leather belting are shown by the J. C. McLaren Belting Company, of Montreal and Toronto. This firm have been making leather belts for forty-seven years, and manufacture only high grade English oak-tanned stock. Their little booklet "What Makes the Wheels Go" contains much information regarding the use and operation of belts in general.

D. K. McLaren, of Montreal and Toronto, show English oak-tanned leather belting, balata and rubber belting, as well as card cloth, cotton mills supplies and belt hooks.

The Dominion Belting Company, Hamilton, have been in business but a short time, but their display indicates that they are strong competitors for the belting trade. They show the "Maple Leaf" brand of stitched cotton duck belting, also "Maple Leaf" belt dressing, claimed to add materially to the life and efficiency of a belt.

R. H. Buchanan & Company, 692 Craig street, Montreal, are agents in Canada for the Rider-Ericsson hot air pumping engine, of which two sizes, 6 and 8 inch, are shown. This engine is used largely for pumping water.

Bradley, Levy & Weston, of Toronto, have on exhibit an automatic smoke preventer which is attracting considerable attention, also a nice line of "Crown" valves manufactured by the Stouffville Brass and Steel Works, of Stouffville, Ont. This valve is said to embody features of construction different from others on the market.

The Turner Brass Works, Chicago, are represented by A.C. Anderson, 8½ King street east, Toronto, who is in charge of their display of gasoline blow pipes, carborator valves, porcelain furnaces, etc.

The Draper Manufacturing Company, of Port Huron, Mich., show valve-facing tools, ball check valves and the McGrath pneumatic flue welder.

Visitors have inspected the exhibit of the Henderson Roller Bearing Company, of Toronto, with much interest. A machine, which is particularly heavy, is driven by a ¼ horse power motor, and it is only just to the company to state that it is a very convincing demonstration of the efficiency of the Henderson bearing. The Chapman Double Ball Bearing Company also have a splendid exhibit. Much of the power provided in the building is distributed through shafting fitted with the Chapman double ball bearing. Canadian Bearings, Limited, is a competitor in the same field. A trolley wheel is shown which has been in operation the past week at a speed of 1,000,000 revolutions every ten hours, and no heat is discernible.

The large Goldie & McCulloch engine operating the shafting on the north side of the hall is driven by a 20 inch 3-ply belt manufactured by Sadler & Haworth, of Montreal and Toronto.

ENTERING THE CANADIAN FIELD.

Messrs. Read & Kilmer, 39 James street south, Hamilton, have been appointed Canadian representatives of the Fuller Wenstrom Electrical Manufacturing Company, of London, England. The latter company is the English branch of the Swedish General Electric Company, a large concern with factories at Christiana, Stockholm, Gottenburg, Vestras, Helingsfor and London. They manufacture a complete line of single and polyphase generators and single and polyphase induction motors, wound for any voltage, speed or frequency.

Mr. C. E. Kilmer, of the firm of Reid & Kilmer, spent the greater part of last winter in London making arrangements for the representation of the Fuller Wenstrom Company and inspecting the apparatus, which he found exceedingly satisfactory both as to mechanical and electrical details. On account of being able to take advantage of the preferential duty, the firm expect to obtain a considerable share of the Canadian trade. They have already received an order from the Hamilton Steel & Iron Company for a 850 h.p. induction motor and a number of smaller motors for operating the rolling mills, these to be delivered by December 1st next. This, it is claimed, will be the first instance on the American continent where rolling mills have been driven electrically. The large motor will be wound for three different speeds, namely, 275, 250 and 200 revolutions. On the rotor there are three different sets of windings that may be thrown in to give the different speeds, and the power factor will be 90 at any one of these speeds. Lower speeds down to zero will be obtained by cutting an external resistance into the rotor circuit.

The directors of the Valley Telephone Company have decided to extend the metallic line next year from Middleton to Bridgetown, N.S., and to lay a new cable across the Annapolis river at the Ferry.

The Bell Telephone Company have been given a five years' franchise by the city of Kingston, Ont. The company will put in an underground system in the business section and expend a considerable sum on new plant.

QUESTIONS AND ANSWERS

J. W. Smith : I have a 125-volt direct current dynamo which I want to equip with a pair of collector rings, so as to get some alternating current. Can you tell me what the voltage will be, and also the frequency ?

Ans.—If you put on only a pair of collector rings you will get a single phase, the voltage of which will theoretically be .707 of the direct current pressure. That is, you will get about 88 volts between your two rings, though the design of the particular machine in question may make this either a little higher or lower. We cannot tell you the frequency, as this depends on the speed and number of poles ; it can be found by dividing the product of the number of poles and the speed in revolutions per minute by 120, the result being in cycles per second.

"Enquirer" : In charging storage batteries I have been told to be careful that the charging current is not too strong. What harm will it do if it is, and is it possible to have it too small ?

Ans.—The principal difficulty from the use of too high a charging current is that it is apt to cause buckling and consequent destruction of the plates. This buckling is the result of unequal expansion and contraction of the paste in the plate, an inevitable result of too great a current density, either in charging or discharging. Another result of charging at too high a rate is that the process is then less efficient, as is evidenced by the increase in both the heating and the amount of gas given off. On the other hand, if the charging current is too small it results in the production of a film of white sulphate on the positive plate, instead of peroxide, which if allowed to grow will very soon stop any action whatever.

"W.H.," Montreal : Would you be kind enough to explain the principle of the Brotherhood engine, and how it gets its name ?

Ans.—We do not know that the Brotherhood engine has any special principle used in it which is not found in any other steam engine, though the arrangement of the various parts is decidedly novel. In the first place the three cylinders are placed 120 degrees apart, something after the method used in pulp grinders, the whole three acting onto but one crank pin. It is single acting, steam being used on one side only of the piston. Its admission is controlled by a throttling governor valve, three piston valves distributing it to the various cylinders. It is exhausted through ports which are uncovered by the pistons as they reach the end of the stroke. These latter are of the trunk form, that is, they form the crosshead as well as the piston, and thus the connecting rod and the piston rod are merged into one. The engine gets its name from Mr. John Brotherhood, who introduced it about 1873, it being one of the first high speed engines brought out for direct connection to dynamos.

"S. M." : Is there any difference between the terms inductance and reactance, or do they mean the same thing, also what is impedance ?

Ans.—The impedance is the term in alternating current work which corresponds to resistance in direct current. It is composed of two factors, one consuming energy, being the resistance of the circuit the same as if it were carrying direct currents, and the other consuming voltage, but being wattless, and called the reactance. Again reactance is divided into negative and positive. Positive reactance is due to electro magnetism and is known most commonly as self inductance or inductance. Negative reactance is due to capacity and is usually known as condensance.

"Station Man" : What is the object of the brass horns on some forms of lightning arresters ; does it matter how they are connected into the circuit ?

Ans.—The horns are put there to form an air gap of gradually increasing width, which, while narrow enough at the lowest point to let the discharge jump across, is wide enough at the top to stop the dynamo pressure from holding the arc. They are always put in with the wide part of the horns to the top so that as the hot vapor which composes the arc rises it will have a wider and wider gap to span. There is a right and a wrong way to connect them in,it being necessary to see that the blown out coil tends to send the arc upwards, if it goes the other way it will be sure to cause trouble. There are usually marks or tags on the various terminals showing how they should be wired.

"Practical" : Can I operate a 9½ ampere arc dynamo, which has been running open arc lamps, on a circuit of 6.6 ampere enclosed lamp ?

Ans.—It is very doubtful if you can do this. In the first place the machine may not be stable, that is, it may not keep up its voltage if the current be reduced to this point. Again, even if it would the armature voltage will be considerably reduced owing to the weak field. You might possibly get better results by winding more turns onto the field, or by separately exciting it from some small machine. In any case you will not likely be able to operate the regulator, nor even if you got the same voltage from the armature, would you be able to operate the same number of lamps, as the enclosed type take 80 volts each as against 50 for the open style.

"Student" : What are the equalizing rings on an armature, and what are they for ?

Ans.—These are a set of rings, varying in number depending on the size of the machine and the number of the poles, mounted usually on the back end of direct current armatures with multiple windings, and connected to the proper points therein. Their function is to equalize the voltage generated in the different sections of the armature so as to prevent local currents flowing through the brushes and commutator and thus causing bad heating and sparking. They operate by carrying alternating currents back and forth between the high and low sections, if any such should exist, these currents tending to magnetize the weak poles and to demagnetize those which are stronger. They are especially useful if the armature gets out of place in the field, due to wear in the bearings or any movement of the machine.

Tenders have just been invited for lighting the streets of the town of Durham, Ont., by arc or incandescent lights.

THE METRIC AND THE ENGLISH SYSTEM.

By James Asher.

Shall we adopt the metric system of weights and measures? The vast commerce between countries in which the English language is used and those in which it is not used seems to demand that only one system be adopted for the sake of uniformity and simplicity. A host of clerks are employed in translating weight and measures of articles which are imported and exported.

The metric system is used in nearly all European countries, South America and Mexico. The advocates of the metric system claim that it is simple and easily learned. The metre when constructed was declared to be the ten millionth part of the distance from the equator to the north pole, measured on the meridian of Paris. The metre is subdivided into tenths, hundredths and thousandths, called decimetres, centimetres and millimetres. Also ten metres are called a dekametre, ten dekametres are called a hectometre, and ten hectometres are called kilometre. The kilometre is used for measuring long distances as on roads and railways. A common man can walk 5 kilometres in an hour.

The measures of capacity are derived from the unit of length, thus: One cubic decimetre is called a litre, ten litres are called a hectolitre, and ten hectolitres are called a kilolitre. The tenth part of a litre is called a decilitre, the hundredth part of a litre is called a centilitre, and the thousandth part of a litre is called a millilitre. A cubic metre is called a stere.

The weights are connected with the measures, thus: A cubic centimetre of distilled water at its temperature of maximum density, 4°C or 39.2°F, and when the barometer is at 760 millimetres, is said to weigh a gram. Ten grams equal a dekagram, ten dekagrams equal a hectogram, and ten hectograms equal a kilogram. A man of average weight may tip the beam at 68 kilograms. The tenth of a gram is called a decigram, the tenth of a decigram is called a centigram, while the tenth of a centigram is called a milligram. A cubic metre of water is said to weigh a tonne. This is used in measuring very great weights, and is a little more than the English ton.

One very great advantage claimed for the metric system is that reduction from either a higher to a lower, or from a lower to a higher denomination is performed by merely shifting the decimal point.

Mr Gladstone said that the metric system would cause a greater saving of labor than the steam-engine. Sir William Thomson, now Lord Kelvin, is an ardent advocate of the metric system. He calls the English system a wickedly brain destroying system. He never uses the English mile if he can prevent it. He would use the knot, or nautical, or sailors' mile of 6070 feet, if obliged to use miles.

On the other hand Sir Edmund Beckett, now Lord Grimthorpe, in a fierce onslaught on the metric system? says that the metre is not what it pretends to be, for it is not exactly the ten millionth part of the distance from the equator to the north pole, measured on the meridian of Paris; that it was invented by a nation whose language is declining over all the world, and that the English language, with that standard of measures which every man carries in his arms and his legs, is spreading over all the world and will soon be the only universal language. Absurd doctrinaires may cram penny-school girls with French metres, and centimetres, and kilograms, but our yard grew and will remain as the natural standard of length until the stature of the human race alters. For it is the length of a good stride of a man of what is generally considered the best height, and that height is two such lengths, and so is the stretch of his arms, and a yard is the natural length of his walking stick. The metre would be the walking stick of a nation of giants. With the yard goes the equally natural and still older measure of a foot. See, Clocks, Watches and Bells, 6th edition, page 38.

Sir John Herschel said that the choice of the quadrantal arc of the earth's meridian, in the metric system, was a sin against geometrical simplicity, and that the polar axis of the earth, that is, the distance through the earth, which is a straight line, from the north to the south pole, should have been chosen instead.

Were the metric system at once adopted in countries where the English language prevails all the countless millions of weights and measures would become useless. The greatest confusion would prevail for a long time. In making repairs for old machines, and in the renewal of portions of buildings even, great inconvenience would be felt because the yard and the metre are what mathematicians call incommensurables, that is, there is no common measure of the metre and the yard. A man fifty years hence might need a new pane of glass for an old window. He would require the exact size of what is now called a pane 8 inches by 10 inches. Panes of that size would almost certainly not be manufactured fifty years hence. Yet the new pane would have to fit exactly. The man would ask for a pane 20.31 centimetres broad, and 25.39 centimetres long. The hardware clerk would then get a diamond and cut a larger pane.

The roads in the British Empire and in the United States are placed at certain distances apart, either a mile or some convenient multiple or some fraction of the same, for example ½ mile, ¾ mile, 1 mile, 1¼ mile, 1½ or 2 miles. Now these distances are practically fixed for countless thousands of years. Let us suppose that a man inquiring his way in the year 3000 is told by the small boy that it is 1.609315 kilometres to the next road—a distance which we now call a mile.

Farms in the British Empire and in the United States frequently contain 100 acres. In the metric system the unit for measuring land is the hectare. One hundred acres are equal to 40.467101 hectares. Now the sizes of the farms are practically fixed, for there are a certain number of farms from one road to the next road, and we have seen that the positions of the roads are now fixed. Having been laid down according to the English system they can be expressed in the metric system only by awkward whole numbers and decimals.

Suppose that a farmer in the year 3000 makes his will thus:

"In the name of God, amen:

I, John Doe, being of sound mind and body, do hereby declare that this is my last will and testament. I do hereby give and bequeath one moiety of the farm now unto me belonging, said farm being a parcel of land containing 40.467101 hectares, said moiety consisting of 20 23355 hectares; the other moiety I do hereby give and bequeath in equal shares, that is to say, I give and bequeath to my two remaining sons, James and his brother Zebedee, share and share alike, or I give, present, and bequeath unto them and to their heirs for ever, to each 10.116775 hectares of the said farm now unto me belonging."

The English system can be simplified by discarding a number of unnecessary weights and measures. The pint, the quart, the gallon and the bushel in the United States are smaller than the pint, the quart, the gallon and the bushel used in the British Empire. To make matters worse the pint and the quart of dry measure in the United States are different from the pint and the quart used in the same land in measuring liquids. What is the use of having the long ton of 2240 pounds in addition to the common or short ton of 2000 pounds? What is the use of having a hunured weight of 112 pounds in addition to the common hundred weight of 100 pounds? What is the use of having troy and apothecaries weight in addition to avoirdupois weight? What is the use of having the statute mile of 5280 feet in addition to the knot or nautical or sailors' mile of 6070 feet? What is the use of measuring the depth of the sea in fathoms of two yards each, instead of measuring it simply in yards? Why should a man measure the height of horses in hands of 4 inches each instead of simply measuring in inches? Of what use is the rod—5½ yards? This 5½ is troublesome to school children. What is the use of weighing people by the stone of 14 pounds in Britain? Not only do they there have the unnecessary stone in weighing human beings but they have a different stone of 8 pounds for weighing butchers' meat and fish. What is the use of two different hogsheads—the hogshead of beer containing 54 gallons, and the hogshead of wine containing 63 gallons?

The abbreviations for some of these units should be changed, for example dwt stands for penny weight, oz stands for ounce, lb stands for pound, cwt stands for hundred weight and £ stands for pounds in money. The abbreviations are from French and Latin words, for example dwt stands for denarius weight. Denarius is the Latin for penny. Smooth the path of the young by abolishing foreign abbreviations, and abolish useless weights and measures.

INTERESTING SUIT AFFECTING ELECTRIC COMPANIES.

The arbitrators in the case of the Consumers' Electric Company vs. the Ottawa Electric Company handed down their decision on August 10th, which was in favor of the plaintiffs. At the time the city council granted the Consumers' Company permission to do business in the city it was stipulated with the agreement of the Ottawa Electric Company that the Consumers' Company should be allowed to string wires on the rival company's poles on certain streets. The Ottawa Electric Company, however, afterwards refused this permission on the ground that the stringing of the Consumers' wires on its poles would impair the efficiency of its service. The Consumers' Company brought action against the Ottawa Electric Company in the high court. After hearing the argument of counsel, Sir William Meredith, the presiding judge, decided that the question at issue was one in which the scientific aspect overshadowed the legal bearing and he accordingly decided to refer the matter to arbitration. Three members were appointed, one by the court and one by each of the companies. The members were James B. Cahoon, of New York, appointed by the court, R. S. Kelsch, of Montreal, appointed by the Consumers' Company, and H.D. Bayne, of Montreal, appointed by the Ottawa Electric Company.

The finding determines the right of the Consumers' to string wires on the poles of the Ottawa Electric on payment of a rental of $1 per pole yearly. This applies, amongst other streets, to Rideau, Elgin, Metcalfe, Lisgar and Cooper. The Ottawa Electric is assured a corresponding use of the Consumers' poles. The cost of the arbitration proceedings is equally taxed upon both parties, while the cost of the legal action which preceded and resulted in the arbitration, must be wholly borne by the Ottawa Electric Company, defendants in that action.

When the Ottawa Electric Company, which consists of the several companies doing lighting and power business in the City of Ottawa at one time, was allowed to consolidate under one management and form The Ottawa Electric Company, the consolidation was allowed by the City Council, who passed a by-law authorizing the consolidation under certain conditions. The principal clauses in this by-law read as follows :—

1. "That the Companies will permit and allow the Corporation or any person or persons, Company or Companies, authorized by the Council and the Corporation, to use the poles of the Companies for electric purposes, on paying to the Companies such compensation for such privileges as in the event of the parties being unable to agree, shall be determined by arbitration, as hereinafter in this section mentioned, provided, however, that such privilege shall not interfere with the efficiency, operation and completion of the system of the Companies, and provided further that the privilege by this clause conferred shall not be extended to any Company which shall receive a like privilege to the Companies."

The word companies used in this paragraph refers to the several companies which form the Ottawa Electric Company.

2. " Said compensation shall be such as may be agreed upon by the Companies and the said Corporation or such other person or persons, Company or Companies, so authorized to obtain such privileges as aforesaid as the case may be, and in the event of their being unable to agree, such compensation shall be referred to the determination and award of two arbitrators, one chosen by each of the said parties to such dispute."

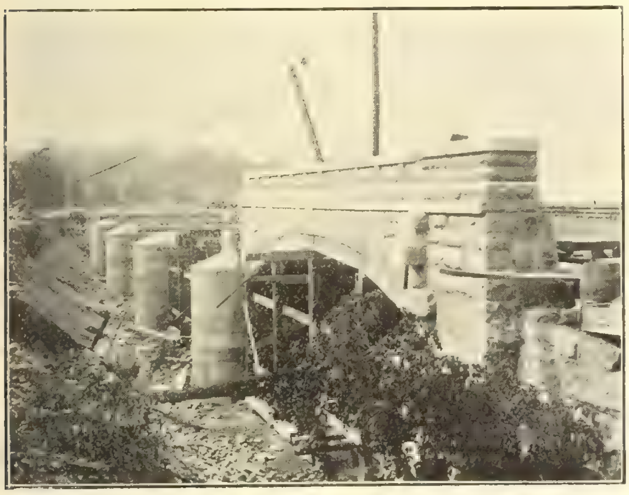
We understand that the arbitrators were unanimous on four of the six points in dispute, the Ottawa Company's arbitrator dissenting, he being unable to agree with the other arbitrators on two points, being the question of costs of the suit and the question of sufficient pole space for the Consumers Company on all of the poles.

The Grand Trunk Railway have recently installed a new system of telephone and telegraph. The system is a composite circuit telephone and telegraph, operated on one wire circuit, and is so arranged that one instrument does not interfere with the workings of the other. At present this new device is in operation between Montreal and Brockville, instruments having been placed in the despatcher's office, at Montreal, Vaudreuil, Cornwall and Brockville stations. This system doubles the usefulness of the wires wherever installed, and enables the divisional officers to communicate with those along the line by voice, and materially expedites the handling of matters pertaining to train movements. Whilst it is in the nature of an experiment, the results thus far justify the belief that the system will be universally adopted throughout the different districts of the Grand Trunk System.

BRIDGE FOR THE CANADIAN NIAGARA POWER COMPANY.

By Orrin E. Dunlap.

A bridge that is being built by the Queenston Quarry Company for the Canadian Niagara Power Company has several interesting features. The site of the bridge is in Queen Victoria Niagara Falls Free Park, and it is to span the canal inlet leading to the forebay in front of the power station of the Canadian Niagara Power Company. When completed it will be one of the links in a beautiful driveway along the upper Niagara River on the Canadian side, a locality that is just at present undergoing numerous changes as a result of the extensive power development now taking place there. These changes call for many new features, and this bridge is one of them.



New Bridge for Canadian Niagara Power Company.

The bridge is to be a concrete-steel structure with stone facing, and in general appearance will resemble somewhat the new bridge erected some months ago between the mainland and Goat Island on the New York side of the river. The length of the bridge to end of posts will be 298 feet. There will be five spans, each of 50 feet, and they will have rises of five feet. The piers will be eight feet wide on the face of the bridge and 66 feet 3¾ inches long to outside of cutwaters. The piers are set on bedrock, necessitating four or five feet of excavation. The stone used in the bridge is from Queenston, Ont. The piers below the springing line are pointed. The belts, washes and the coping are all of fine dressed work. Steel ribs spaced three-foot centers will be imbedded in the concrete of the arches. Portland cement is being used exclusively on the work.

The width of the bridge is to be 55 feet over copings, except at the piers, where there is a projection of about a foot, making the width of the bridge at the widest part about 57 feet. Inside of the copings the width is 52 feet, and of this 26 feet is to be devoted to double tracks of the Niagara Falls Park & River Railway, an electric line that skirts the river on the Canadian side, 20 feet to the driveway, and six feet on one side to a granolithic walk. The roadway is likely to be of porous gravel or cinders finished with macadam. The grade of the roadway will be practically level, the gutters being graded from the center of each arch to the piers, catch-basins being placed over each pier. Drainage is provided to be carried off in cast iron pipes that will discharge at about the springing line of the arch. It may be pointed out that the arches were made of such small rise in order to avoid raising the railway tracks, which will be on a fill approaching the bridge. The abutments of the structure are built of concrete in which large stones are imbedded. A conduit having four compartments has been built in the sidewalk for carrying electric wires for lighting the bridge, a pipe being inserted in each of the main posts. The specifications call for a loading of 5,000 lbs. per lineal foot on one track of the railway, and 100 lbs. per square foot on the driveway.

The arches and backing of the spandrel walls and the piers above springing line, are to be built of Portland cement concrete, the proportions of which are to be one part cement, two parts sand and four parts broken stone. In the piers below the springing line the proportions of the concrete are to be one part cement, three parts sand and six parts broken stone. In the construction of the bridge the contractor is required to trowel two inches of mortar onto the lagging in order to give a smooth surface on the concrete of the soffit of the arch. In building, the contractor is required to start the concrete simultaneously from the ends of the arch and lay it in longitudinal sections. While being built, timber forms hold the sections in place. The tops of the arches and backs of the spandrel walls are to be given two coats of pure Portland cement grout applied with brushes and then covered with two thicknesses of felt. This is in order that the arches may be made waterproof so that the dampness will not come through and stain the masonry.

Before the construction of the bridge a coffer-dam was built between the site and the waters of the river. The water that will pass beneath the bridge will flow to the turbines in the wheel-pit of the Canadian Niagara Power Company. High water will be 1.37 ft. above the springing line of the arch, which will be a depth of 17 9-10 ft. of water in the inlet canal. Low water will be 3.93 ft. below the springing line of the arch, or a depth of 12 6-10 ft. of water in the canal, while the mean stage of water will be 1.83 ft. below the springing line, or a depth of 14 7-10 ft. in the canal.

This beautiful bridge was designed by William A. Brackenridge, one of the consulting engineers of the Canadian Niagara Power Company, and the structure is being built under the direction of Cecil B. Smith, resident engineer of the Canadian Niagara Power Company. It is without doubt to be one of the most beautiful bridges on the Canadian side at Niagara, and will be a material factor in adding to the new beauty of Victoria Park. Its magnificent lines and fine appearance will go well toward showing that even though industry has invaded the Canadian pleasure ground at Niagara, it is the intention of the park commissioners, and also of the Canadian Niagara Power Company, so far as it is concerned, to do nothing that will mar the natural beauty of the surroundings of the falls.

New Bridge for Canadian Niagara Power Company.

MUNICIPAL STEAM TURBINE PLANT.

An interesting municipal electric lighting plant enterprise is under way at Anderson, Indiana, and marks the second introduction of the steam turbine in American municipal power plant service. The City of Anderson has for some years operated an electric light plant in connection with the city water works, located near White River. The electric installation is housed in a separate building approximately 50 x 100 feet, adjacent to the water works plant whose boilers furnish the steam power necessary for the operation of the electric light plant.

The present lighting equipment comprises two belted generating units, but the increasing demand for light and power renders the available capacity inadequate to carry even the present load at times, resulting in a severe overloading of the entire equipment. In order to secure immediate relief from these conditions and avoid the necessity of erecting additions to the power house, Westinghouse steam turbine generating units have been selected for power extensions. At the present time two 400-K.W. units will be installed, together with one 20 K.W. exciter, direct connected to a Westinghouse standard engine, and a complete switchboard equipment.

As the result of the employment of turbines in this plant it has been found possible to install a complete boiler plant in the electric light building, thus rendering the operation of the lighting system entirely independent of the water works system. The new boiler plant consists of three 310 h.p. Sterling water-tube boilers equipped with Roney mechanical stokers. The boilers will not be arranged for superheat, but will supply saturated steam to the turbines at 150 lbs. pressure, all condensation being returned to the boilers by a steam loop and Holly gravity return system. The turbo-generators will furnish three-phase current to the lighting, power and distributing system at a frequency of 7200 alternations and at 2200 volts pressure, no step-down transformers being used. The turbine equipment will operate condensing, as the plant is located near the river bank where condensing water is available. Surface condensers will be used and the condensation from the turbines will be returned directly to the boilers, as the exhaust is entirely free from oil.

An interesting feature of the turbine installation is brought out by the fact that by replacing the belted units with turbine driven units, sufficient space is made available for the installation of the complete boiler plant, together with an additional turbine unit and the necessary boilers at such times as the future demands upon the plant require this extension.

A movement is on foot to build an electric railway from Guelph to Orangeville, Ont.

The gas engine exhibit at the Louisiana Purchase Exposition will doubtless be one of the most important features of the power display, for it will not only contain many types of engines, but also several of unusual size, including one of 3,000-horse-power, which will be the largest ever built. Mr. Thomas M. Moore, chief of the department of machinery, states that there will be several such engines of over 1,000 horse-power and a few of more than 1,750 horse-power. The largest gas engines hitherto exhibited were those at Paris and Dusseldorf, which were rated at 600 horse-power. While this class of engines will be so fully represented, the equally interesting type of steam turbines will probably be just as thoroughly covered; in fact, the largest prime mover at the Exposition will be an 8,000 horse-power Curtis turbine.

THE BURSTING OF EMERY WHEELS.

Several years ago the writer was consulted regarding some points of a case in litigation occasioned by the bursting of an emery wheel and the resulting death of a workman. The question to be decided was whether the wheel was unsafe at the speed recommended by the makers, or whether the accident was due to the carelessness of the operator.

As it was just then an "off" year for experiments on fly-wheels there seemed to be no good reason why the same medicine could not be tried on emery wheels. The apparatus already described in former papers read before this Society, with some slight alterations, was adapted to the new requirements, and in the spring of 1902, fifteen wheels of various makes were tested to destruction.

TABLE.

No. of Test.	Grade Mark.	No. of Emery.	Working Speed.		Bursting Speed.		Speed Ratio.	Factor of Safety
			Revs. per Minute.	Feet per Minute.	Revs. per Minute	Feet per Minute.		
1	4.5	20	1,200	5,030	3,100	13,000	2 58	6.67
2	.5	20	1,200	5 030	3,200	13,400	2 67	7.14
3	4.5	20	1 200	5,030	3 350	14,020	2 79	7 73
4	Q	30	1.250	5.230	3,750	15,700	3.00	6.00
5	Q	30	1,250	5.230	2,750	11.500	220	4 84
6	H	30	1,400	5,870	4,550	19.050	3.25	10.56
7	H	30	1,400	5,870	4,600	19,200	3.28	10.76
8	O	36	1,250	5.230	4,100	17. 00	3.28	10.76
9	O	36	1,250	5 230	4 125	17,250	3.30	10.89
10	2.5	60	1.150	4.830	2,700	11,500	2.39	5 71
11	2.5	60	1,150	4.830	2,900	12,100	2.52	6.35
12	M.H.	14	1,200	5 030	3,100	12,970	2 58	6 66
13		24	1,200	5,030	3,800	15 900	3. 7	10.00
14	H	10–12	1,200	5,030	4.100	17,200	3 42	11.70
15	H	10–12	1,200	5,030	4,350	18,200	3 62	13.10

Tests 6 and 7; wheels made with wire netting; tests 14 and 15, with vulcanized rubber.

For the actual details of the work credit is due to Messrs. Chandler and Krueger of the class of 1902, Case School of Applied Science. Most manufacturers of this class of wheels test them for their own information, but the results are not generally given to the public; the writer knows of no published data on this subject. At the Norton Emery Wheel Works, all wheels are tested before leaving the shop at a speed double that allowed in regular service, and occasionally wheels are burst to determine the actual factor of safety.

Emery-wheel accidents are not uncommon, but can usually be traced to the carelessness of the operator. One common cause of failure is allowing a small piece of work to slip or roll between the wheel and the rest. The writer was once present on an occasion of this kind, and although he fortunately was not in the plane of rotation, he has never forgotten his sensations

The wheels selected for the experiments were all of the same size, being sixteen inches in diameter by one inch thick, and having a hole one and one-quarter inches in diameter.

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*Papar read before Saratoga Convention of A. S. M. E., by Prof. C. H. Benjamin.

The object of the experiment being to determine the bursting speed of such wheels as are actually on the market, emery wheels were obtained through various outside parties without indicating to the agents or manufacturers the use to be made of them.

In this way wheels of six different makes were obtained, the label on each wheel showing usually the maker's name, the grade number or letter, the quality of emery, and the speed recommended for use. As shown in the table of results, the working speed varied in the different wheels from 1,150 to 1,400 revolutions per minute, the average being about 1,200 revolutions per minute. For a diameter of sixteen inches this corresponds to a peripheral velocity of about 5,000 feet per minute. The table also shows that the fineness of the emery varied from ten to sixty, the average being about thirty.

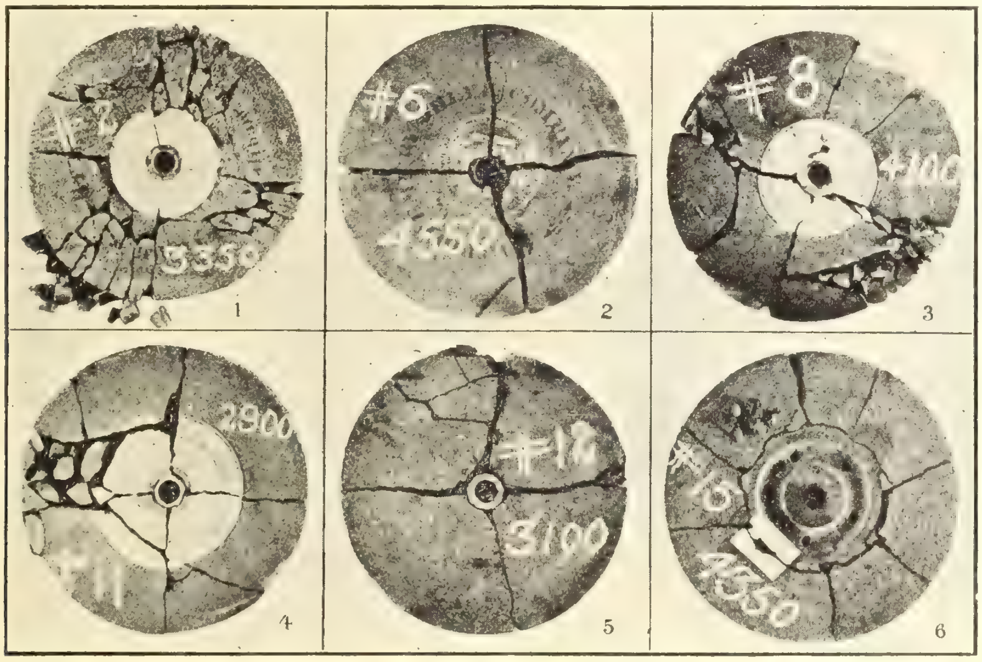
The wheels were held between two collars, each six and one-eighth inches in diameter and concaved, so as to bear only on a ring three-fourths of an inch wide at the outer circumference.

Nos. 12 and 13, of still another make, burst at about the average speed. (Fig. 5.) Wheels Nos. 14 and 15 were so-called vulcanized wheels, containing rubber in the bond, and intended for particularly severe service. These showed, as was expected, rather more than the average strength. (Fig. 6.)

An examination of the last two columns in the table shows that the wheels burst at speeds varying from two and one-quarter to three and three-quarters the working speed, and accordingly had factors of safety varying from five to thirteen.

It is then apparent that any of these wheels were safe at the speed recommended, and would not have burst under ordinary conditions. At the same time, considering the violent nature of the service and the shocks to which they are exposed, it would seem that the factor of safety for emery wheels should be large. In comparison with those generally used in machines, a factor of eight or ten would seem small enough.

It may also be said that such a variation in strength between wheels of the same make and grade, as for instance that between Nos. 4 and 5, indicates a lack of uniformity which causes distrust.



Results of Experiments on Emery Wheels.

The method of testing, and the apparatus used, were precisely similar to those described in the paper on "The Bursting of Small Cast-iron Flywheels," by the author at a previous meeting, to which reference is made for illustrations of the apparatus.

The table shows the results of the experiments in detail, and needs but little explanation. The illustrations, Figs. 1 to 6, show characteristic fractures, and the appearance of various wheels after bursting.

Wheels numbered 1, 2, and 3 were of one make, and show a remarkable uniformity in strength. (Fig. 1.)

Nos. 4, 5, 8, and 9 were all made by one firm; the two latter wheels were of finer grain than the others, and show a correspondingly greater strength. (Fig. 3.)

Nos. 6 and 7 contained a layer of brass wire netting imbedded in the emery, and were about one-third stronger than the average of the ordinary wheels. (Fig. 2.)

The wheels numbered 10 and 11 were the weakest among those tested, but have an apparent factor of safety of between five and six. (Fig. 4.)

The fractures were in the main radial, as may be seen from the cuts, the wheel splitting in three, four or five sectors as might chance.

It may be assumed that these radial cracks started from the rim where the velocity and stress were greatest, but it is a fact worthy of notice that in nearly every instance the cracks radiated from points where the lead bushing projected into the body of the wheel.

The citizens of Whitby, Ont., have declared themselves in favor of taking over and extending the existing electric light plant.

The town of Lucknow, Ont., will likely purchase the electric light plant from the owners and install a modern system. Mr. H. F. Strickland, electrical engineer, of Toronto, has the matter in hand for the town.

The Thos. E. Clark Wireless Telegraph-Telephone Co., of Detroit, Mich., announce that they are erecting stations at Pontiac, Mich., on the State Fair Grounds, for the purpose of carrying on commercial telegraphing.

ENGINEERING and MECHANICS

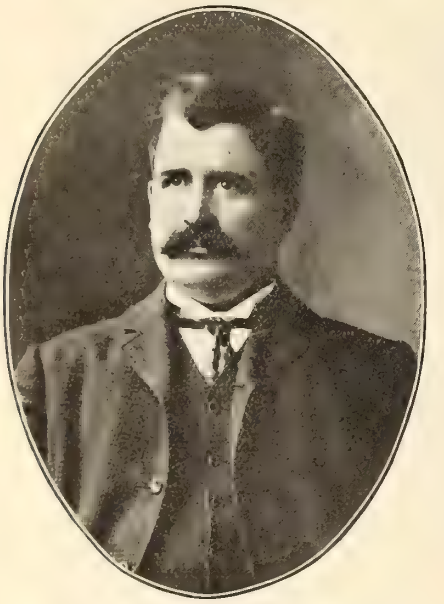
ANNUAL CONVENTION OF STATIONARY ENGINEERS.

The fourteenth annual convention of the Canadian Association of Stationary Engineers took place at Berlin, Ont., August 25th and 26th. The headquarters of the delegates was the Walper House, the proprietor of which is Mr. George Philip, a brother of Mr. E. J. Philip, of Toronto, an old member of the C.A.S.E. The business sessions were held in the council chamber. Those present included the following :

W. Oelschlager, Berlin, president ; H. E. Terry, Toronto, vice-president ; W. Inglis, Toronto, secretary ; J. Ironsides, Hamilton, treasurer ; N. Beam, Waterloo, doorkeeper ; J. Struthers, Sarnia, conductor ; N. V. Kuhlman, A. M. Wickens, G. C. Mooring, J. Huggett and J. M. Dixon, Toronto ; W. F. Crockett and S. Sculthorpe, Hamilton ; J. R. Uttley, Waterloo ; T. King, Dresden ; J. H. Walker, Berlin ; J. Ogle, Brantford ; A. M. Turkington, Brockville ; D. McEvoy, Toronto, representing the Fairbanks Company.

PRESIDENT'S ADDRESS.

In his presidential address W. Oelschlager pointed out the importance of the convention, which would probably determine whether the Association would be carried on or would cease to exist. He urged the continuance of the work and the broadening of its field, and suggested that efforts be made to re-organize defunct local associations. He suggested the continuance of the lesson papers and to make them progressive, that is, lead them up gradually from the primary to the mathematical problems required to be answered by certificate examinations, also that the engineers in their respective localities ask their employers to give financial aid to the individual lodges. He expressed the belief that if the Executive of the C. A. S. E. were kept afloat public interest would revive and the association flourish to a greater extent than ever before. In conclusion he respectfully suggested the following :



Mr. H. E. Terry, Toronto,
President Canadian Association of Stationary Engineers.

1. That our preamble be re-inserted in charter and constitution.
2. That a sum of money be voted towards the expenses of visiting defunct lodges with the object of re-organizing the same.
3. That the educational leaflets be pushed more vigorously, and a charge covering printing expenses be made.
4. That our employers be informed that we are hereby asking a cash contribution of them.

The address was referred to the Committee on Good of the Order and the following standing committees were appointed :

Good of the Order—J. M. Dixon, J. Ogle, T. Walker, J. Ironside, H. E. Terry, A. M. Turkington.

Mileage—N. Beam, F. Sculthorpe.

Audit—N. V. Kuhlman, F. Sculthorpe.

Ways and Means—N. V. Kuhlman, W. F. Crockett, G. C. Mooring, T. King, A. M. Wickens, W. Inglis.

Credentials—T. King, A. M. Turkington.

At the afternoon session the minutes of last meeting were read and adopted and the reports of the secretary and treasurer received and referred to the Audit Committee. The secretary reported that nothwithstanding the loss of one order, Sarnia No. 20, the membership stood at 258, a decrease of only four from last year. He had been in communication regarding the formation of lodges at Calgary, Brandon, and Halifax.

Much of the afternoon was devoted to a discussion regarding legislation and the position of the International Union of Steam Engineers, some of the delegates present apparently being in favor of throwing in their lot with that organization. The meeting adjourned early to enable the delegates to visit the sugar refinery at Bridgeport.

Upon resuming at 8.30 p.m. it was decided to receive and discuss the report of the committee on ways and means clause by clause. The report as adopted is as follows :

REPORT OF COMMITTEE ON WAYS AND MEANS.

Clause 1.—That we view with alarm the general tendency towards withdrawing from this Association during the previous year. We beg to recommend that twenty-five questions be formulated, and that the executive give a cash prize for the best solution of them.

Clause 2.—We also recommend that every secretary of a subordinate Association be instructed to write to every sister Association the progress that has been made in this regard, and give a synopsis of the work done in this respect.

Clause 3.—We also recommend that wherever possible, a better intercourse be initiated with each other by means of a system of fraternal visits.

Clause 4.—We also recommend that we use every legitimate effort to build up the Association, and that the sum of $10 be granted to any member who shall organize a new Association or resuscitate a defunct one.

Clause 5.—We also recommend that every Association be instructed to be as aggressive as possible, so as to build up their membership.

Clause 6.—We would also like to see a fraternal spirit shown between members of each Association, and that each individual member aid and assist those who are not so well versed as themselves in the different lines of work.

SECOND DAY.

On Wednesday morning the report of the Committee on Good of the Order was taken up. It recommended that the preamble be amended to suit the present position of the association ; that a sum of money be voted to cover expenses for visiting lapsed lodges, as by a judicious expense the association would be held firmly together and members of small districts could be specially educated in the Brotherhood of the Society ; the continuation of the monthly leaflets as another source of keeping in touch with lodges of a lukewarm character ; that the question of soliciting cash contributions be left in the hands of the local associations.

Concerning the notice of motion that Toronto No. 1, after this session, will withdraw from the Executive of the C. A. S. E., the Committee reported as follows : We sincerely regret that such a resolution should emanate from Toronto, No. 1. It has been the parent of the Association, has fostered and expended money and effort on the development of its life, and now when our existence is seriously imperilled, such attempt at desertion of our ranks is at least reprehensible, but while we deplore this we beg to refer the members of No. 1 to that portion of the constitution on subordinate lodges, Section 2, Article 3, which states that five members in good standing can object, and according to our interpretation can hold all assets belonging to and existing under the charter. Again, in the Executive power, any subordinate lodge failing to return capita tax and other returns specified shall forfeit its charter. Under these conditions we consider it unwise for this present convention to take notice of such motion.'

The recommendations of the committee were adopted excepting that portion dealing with the preamble, which was referred to a special committee consisting of Messrs. Wickens, Moseley, Dixon, King and Crockett. This committee recommended the following as the wording of the preamble: "That this Association shall not at any time be used for religious or political purposes, always recognizing the identity of interests between employer and employee, and always keeping in view the furtherance of mechanical and expert training for its members, thereby proving its close accord with their employers, believing that cultivated brain power is always in demand at fair figures of remuneration."

The recommendation of the committee was adopted. The Executive Secretary was instructed to ask Toronto No. 1 to reconsider its decision to withdraw from the Executive. The question of establishing a Question Box, similar to that of the Canadian Electrical Association, was discussed, but it was felt that the expense involved would be more than the association could stand at the present time.

At the opening of the afternoon session the secretary was requested to read the letters received regarding the possibility of forming new associations. This was followed by a discussion as to the best means of encouraging the formation of branches in the smaller places. It seemed to be generally admitted that if more earnest efforts were put forth the membership of the association could be greatly increased, and it is understood to be the intention of the president-elect to endeavor to awaken in outside places an interest in the work of the association.

The result of the election of officers was as follows: President, H. E. Terry, Toronto (acclamation); vice-president, J. Uttley; Waterloo; secretary, W. Inglis, Toronto (acclamation), treasurer, J. M. Dixon, Toronto; conductor, F. W. Sculthorpe, Hamilton; doorkeeper, J. Ogle, Brantford. It was decided to hold the next convention in Hamilton. The newly elected officers were installed by past-presidents Wickens and Moseley.

The sum of $25 was voted to the Executive Secretary, and $5 to A. M. Wickens for the preparation of instruction papers. A past president's jewel was presented to the retiring president, W. Oelschlager. Votes of thanks were tendered to the local committee, the city council and the local and mechanical press. A brief address by president-elect Terry closed the business proceedings.

THE BANQUET.

The convention concluded with a banquet at the Walper House on the evening of the 26th ultimo, at which about fifty persons were present. W. Oelschlager was the presiding officer. The menu was inscribed on a blue print in an artistic manner, the handiwork of Mr. Oelschlager. The toast of "The King" was followed by "Canada our Home," to which Dr. Lackner, M.P.P., responded. He spoke of the great natural resources of the country and the importance of the engineer in relation to their development. He was in favor of a license law for engineers. Mr. J. M. Dixon contributed a song, which was much enjoyed. To the toast of "The Manufacturers" D. McEvoy, of the Fairbanks Company, and T. King, of Dresden, responded. "Sister Associations" brought a response from W. H. Cone. He stated that 20 years ago when he started to obtain his first engineering experience, the old slide valve engine was in common use. He called attention to the waste of steam caused by running a slide valve engine, but was told by his employer that there was plenty of fuel to burn. To-day we were face to face with a different proposition, the present tendency being to save fuel. He thought that electricity had done more to develop the steam engine than anything else, and concluded by an earnest plea for efficiency in engineering and in electrical work. Messrs. Terry, Inglis, Dixon and Ogle responded to the toast of the "C.A.S.E." and Messrs. Wickens, Mooring and Moseley to that of "Past Presidents". The Presiding Officer and Local Association was then toasted and responded to by Messrs. Oelschlager and Walker. After toasts to the "Press" and the "Host" the function terminated.

The Bell Telephone Company have just commenced the erection of a four-storey building at the corner of St. Andre and St. Catharine streets, Montreal.

Negotiations are stated to be in progress for the absorption of the lines of the Great North-Western Telegraph Company of Canada by the Western Union Telegraph Company.

PRIORITY OF CLAIM FROM INDIA.

Mr. E. J. Lopaz, of the Indian Government Telegraph Department, writes: "I notice on page 67 of the May issue of the Canadian ELECTRICAL NEWS that Prof. Fred Bedall has invented, or rather discovered, a new method of 'transmitting two currents on one wire.' With reference to this, I wish him luck and every success. I beg to point out that in the summer of 1892 I invented a method—a new method—of transmitting two currents on one wire, and used it for duplex telegraphy very successfully on a long overland line 1300 miles in length."

ELECTRIC PLANT AT MEMRAMCOOK.

Messrs. Wm. J. O'Leary & Company, electrical contractors, Montreal, are installing an electric plant in St Joseph's Universitiy at Memramcook, N.B. It will consist of one 56x14 horizontal tubular boiler built by the Robb Engineering Company, of Amherst, N.S.; one 10x10 Robb-Armstrong engine; two 15 k.w. 125 volt Westinghouse d.c. belted generators; and one 3 k.w. 50 volt Westinghouse d.c. belted generators. There will be used as a booster 62 cells of E 13 chloride accumulators and there will be a switchboard of five panels.

The boiler supplies steam at 100 pounds pressure to the engine and also to an 8x8 Robb-Armstrong engine hitherto used in running the laundry. The generators may run singly or in multiple, supplying current to the busses at 125 volts. The booster raises this 50 volts, giving 175 volts between the battery charging busses.

The switchboard consists, as stated, of 5 panels of blue Vermont marble, 48x22x1¼. The first two are the generator panels with the usual instruments, switches, etc; the third a feeder panel; the fourth the booster panel, with connections throwing in the booster and regulating its voltage in charging; the fifth a storage battery panel, supplied with an end cell switch for regulating the voltage in discharging, an overload and an underload circuit breaker, double reading ammeter and voltmeter.

It is proposed to run the engine daily from 5 to 10 p.m. The generators will take care of the lighting load and at the same time charge the battery. The plant will then be shut down and the battery will carry the night and morning load until 5 a.m. the next day. The capacity of the battery is 240 ampere hours on an eight hour basis. Two days during the week the small engine will run the laundry and charge the battery if necessary. In case of a break-down to either an engine or generator or to an engine and generator together the remaining engine can charge the battery during the day and with its assistance carry the evening load without interruption.

The officials of the Montreal Street Railway Company have received copies of the agreement arrived at between the special committee and the management of the company for the organization of a mutual Benefit Association. The affairs of the association are to be managed by a committee composed of five members to be elected annually by the members of the association and an equal number by the Board of Directors of the company, and in addition the general manager of the company shall be president and ex-officio member and chairman of the said committee, five members of the Committee of Management to form a quorum. The company shall contribute to the funds of the association a sum annually not less than 50 per cent., or such larger amount not exceeding 100 per cent. of the annual contributions of the members as the directors of the company may from time to time elect.

A TIDE-MOTOR.

A solution of the old problem of how to get mechanical power from the rise and fall of the tides is attempted by Mr. T. B. Stoney, M. Inst. C. E., of Oakland Park, Raphoe, County Donegal, who has patented a tide-motor driven by large steel floats—boxes open at the top floating in a shallow dock. The float rests on the ground at low water; but the tide rising round the empty float forces it up and carries it to the top of the tide. As the float rises it raises a rack attached to the wall of the dock, and as the rack rises it turns a horizontal shaft on the dock wall. At the top of the tide the float is allowed to fill with water, which weights it to the ground again when the tide recedes. Any number of floats can be used, chained together, and thus any required power can be brought into work; but the movement is, of course, very slow. The inventor points out that in estuaries on the English coast the tidal rise is very great. In the Severn it is 46 ft. at spring tides. Floats working in shallow docks in such estuaries would work night and day at a very small working cost, and might be made to generate electricity at about one-tenth the cost of a steam engine, the electric current being distributed inland by wires.

THE PRESTON AND BERLIN ELECTRIC RAILWAY.

The electric railway from Preston to Berlin, Ont., was officially opened on August 21, although a regular service on schedule time was not commenced until August 26th. This road is in reality an extension of the Galt, Preston and Hespeler electric railway which has been in operation for some years. The distance from Preston to Berlin is about 8 miles. The fare charged for the return trip is only twenty-five cents, or about 1½ cents per mile. It is expected that a large business will be done, as it is the intention to carry freight as well as passengers. The road passes through a fine stretch of country, and as the rolling stock is very fine the tourist traffic should be quite heavy in the summer season. The cars are 53 feet in length, 9 feet wide, and about 15 feet high. They are finished outside in a dark green color, the interior being in quarter-cut oak. There are fifteen seats which provide seating capacity for nearly 100 persons.

Ultimately the power for the operation of this road will be obtained from a power house now in course of erection at Preston, where the road connects with the Galt, Preston and Hespeler Railway. Mr. John Patterson, of Hamilton, was largely instrumental in securing the building of this road.

POWER LOST BY FLYWHEELS.

A series of tests recently concluded at the Nurnberg central electricity station shows very clearly that the resistance which a flywheel offers to the air may give rise in some cases to a considerable waste expenditure of energy. The station in question is provided with two tandem compound engines of 450 horse-power, direct-coupled to the dynamos, and working at ninety-five revolutions per minute. In order to equalize the running with the great variations of load which occur, a very heavy flywheel was used with the arms of a channel section. These arms were found to offer a great resistance to the air and to create a powerful draught. It was therefore decided to cover the wheel with sheet iron in order to reduce the resistance and thus gain considerable power. In order to test the amount of energy lost, the dynamo was made to run as a motor and thus drive the engine and flywheel at no load. When the latter had no protecting covering it was found to absorb 13,300 watts, but when the covering was replaced it took only 9,874 watts, thus showing a gain of 3,426 watts, or 5.7 horse-power, this being 1.2 per cent. of the power of the engine. Counting the current price per kilowatt-hour and a day's run of seventeen hours, it was calculated that this represented an economy of nearly £56 annually. Another test of a similar nature was made upon a 630-horse-power engine, and showed an economy as high as thirty horse-power, or 4.8 per cent. of the engine power, which was gained by properly diminishing the air resistance of the flywheel. — Electrical Engineer (London).

SPARKS.

The Stave Lake Power Company, of Vancouver, B. C., are said to have disposed of their rights to the water power of Stave Lake and Stave River to Mr. Charles H. Baker, of Seattle, Wash. Mr. Baker has had preliminary surveys made and purposes developing the power and transmitting it to Vancouver, New Westminster and possibly Sumas and Seattle. The directors of the Stave Lake Power Company include Sir Thomas Shaughnessy, Sir Charles Tupper, and Messrs. R. H. Alexander, John Hendrie, Thomas Tait, and G. C. Hinton, of Vancouver.

The promoters of the Radial Electric Railway in the county of Kent have received their charter and will commence work at an early date. The first section of the road to be constructed will be from Chatham to Wallaceburg. The chief promoter of this enterprise is Mr. N. H. Stevens, of Chatham.

TO THE TRADE

WE are now in a position to fill orders promptly for Knife Switches of any size from 10 to 1000 Amperes. We have a modern up-to-date factory, using best methods, and making prompt deliveries. We solicit your trade.

The Hill Electric Switch Co., Limited, 426 St. Paul Street MONTREAL

SPARKS.

The ratepayers of Pictou, N. S., have authorized the borrowing of $20,000 for the installation of an electric light plant.

The Stanstead, Que., Electric Light Company have adopted a meter rate of one half cent for 16-candle power lamps per hour.

Messrs. A. F. Barber & Company have made a proposition to install an electric plant for the municipality of North Vancouver, B. C.

The Niagara Peninsula Power & Gas Company has been incorporated by the Dominion Government, with a capital of $250,000. The directors are C. A. Moss, H. J. Wright, John Payne, W. J. Gilchrist and Richard Credicott, all of Toronto.

We are living on the origin of wonderful revelations in the scientific world. If radium can be made available for commercial purposes, steam, electricity and other forces at present made to do man's will, will play a very unimportant part in our industrial life. It is claimed that there is enough force in one drachm of radium to raise five hundred tons a mile high. This makes the ordinary calculation by horse power and voltage look like "the change from thirty cents," to use a familiar simile. The difficulty at present seems to be in getting radium to disintegrate itself in anything but its slow normal method. Should a successful economical application of this force be secured, it is difficult to say what the result will be. It is safe to say, however, that with such immense possibilities just ahead of them investigators will not stop short of some measure of successful results. In thereapeutics there has already been a limited application of this force that warrants the belief that it will be successfully made available in such diseases as cancer. The world awaits with interest further news of the investigation.

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One 10 k.w., 250 volts direct current, Royal Electric Co's. motor, in first class condition. Can be seen by applying to 255 St. James St., Montreal. Will be sold at half the original cost.

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1-75 K W. S.K.C. Generator, 2000-1000 volts, 8000 alternations, with 2½ K.W. Exciter and Station Apparatus complete.

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1-25 K.W. R. E. Co. B-iPolar D. C. Dynamo, wound for 110 volts, with sliding base, pulley, brushes, etc., complete.

2-12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.

The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address

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Our aim is the best, we have no competition if quality is considered.

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GASOLINE ENGINE

$95.
Buys the 2 h.p. "Triton Special" marine gasoline engine, with propeller and complete outfit.

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Buys the 5 h.p. "Triton Special" marine gasoline engine, with propeller and complete outfits. Write for particulars.

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SEND FOR TABLE OF CONTENTS.

5,000 WOOD SPLIT PULLEYS IN ONE ORDER.

The Dodge Manufacturing Company of Toronto recently shipped to England in one order nearly 5,000 of their well known wood split pulleys. This order is not spoken of merely for its size or the fact that it required five full sized box cars to carry the pulleys to the seacoast, but to show that Dodge wood split pulleys have the "call" abroad as well as at home. To meet the tremendous demands which power users make for the Dodge wood split pulley the company has established agencies in all the large centres from Halifax to Vancouver, where stocks of pulleys are carried and where orders are immediately filled. If you have any difficulty in procuring Dodge wood split pulleys or your order is filled with "a just as good" kind, the company will be glad to know of it and will thank you for writing.

SPARKS.

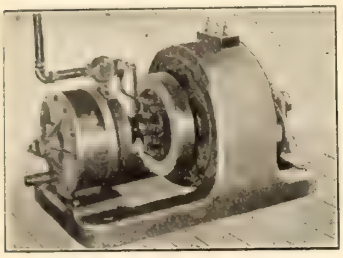
The charter granted to the Menzie Wall Paper Company, Toronto, gives the company power to acquire water powers and to generate electricity.

By a vote of 79 to 1 the ratepayers of Gravenhurst, Ont., have decided to purchase the electric plant from the Gravenhurst Electric Light Company.

The Stuart Machinery Company, of Winnipeg, have furnished an electric light plant for Hon. Thomas Greenway, of Crystal City, Man., to be used for lighting his stables and out-buildings.

The Alexander & Miller Electrical Construction Company have just completed the wiring of the Nicholls Hospital in Peterborough. The conduit of the work was furnished by the Richmondt Conduit Company, of Toronto.

Direct Current Multipolar Generators



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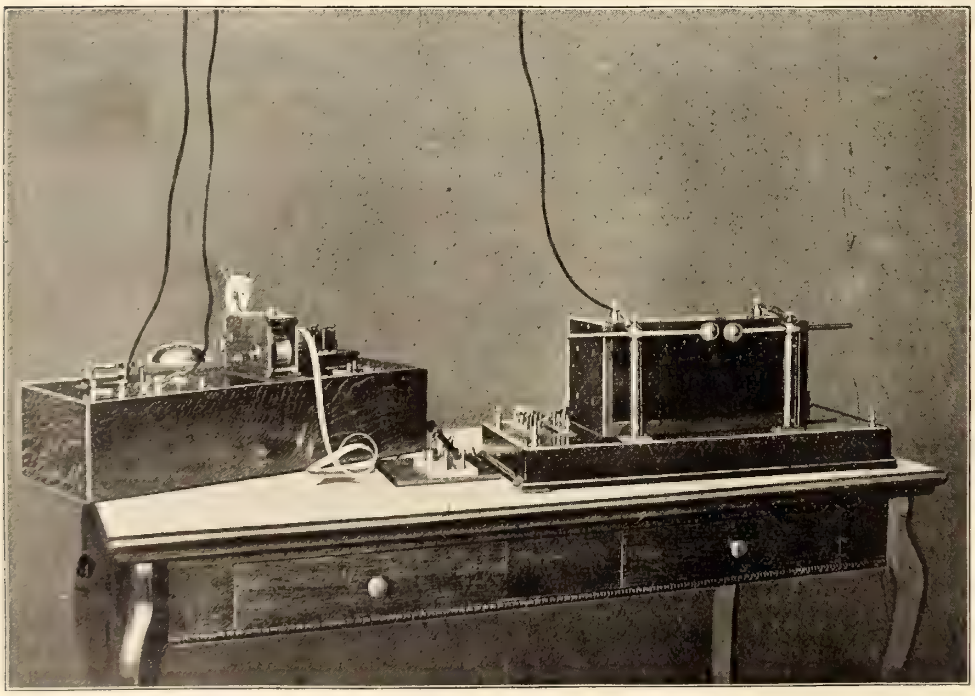

Write us for anything pertaining to Wireless Telegraph Apparatus supplies. We can furnish you separate parts, or any special parts that you may require, **Spark Coils, Coherers, Relays, Registers, Recorders, Automatic Tappers.** We can furnish you prices on Special College Sets, Students' Sets, and also on our special Commercial Wireless Telegraph Sets, for short or long distance telegraphing. Write us for pamphlet and circular, if you are interested in wireless telegraphing.

Clark Wireless System has shown its merit in all tests and requirements. We can fill your order promptly, for high grade apparatus.

Thos. E. Clark Wireless Telegraph-Telephone Company,

DETROIT, MICH.

SPARKS.

Messrs. Dine & McClerie have established boiler works on Birch street, Collingwood, Ont.

The citizens of Wingham, Ont., are discussing the proposed purchase of the electric light plant.

Mr. F. P. Vaughan, electrical engineer, of St. John, N.B., will install a fire alarm system for Rhodes, Curry and Company, of Amherst, N. S.

Mr. Fred Thomson, of Montreal, has been engaged to report upon the establishment of an electric plant by the corporation of Windsor Mills, Que.

Messrs. Dolson & McEwen have been granted a franchise for five years to supply electric light, heat and power to the municipality of Blind River, Ont.

The Bertram Engine Company, of Toronto, have supplied two boilers for the steamer Midland King, of Collingwood. They are 11 feet in length and 11 feet 6 inches in diameter, and of the Scotch type.

A new electric light company has been organized at Lorette, Que., with a capital of $6,000. Messrs. J. A. Verret and Jos. Durand, manufacturers, are interested.

Mr. John T. Wait, of Arnprior, proposes to develop the water power of the Waba river, and has requested the municipal council to co-operate in the erection of a bridge at the mouth of the stream. He would build the foundation of the bridge, which would serve as a dam.

The Town Council of Almonte, Ont., have decided upon developing the present water power for electrical purposes. It is proposed to build a new flume and repair the bulkhead, pier, lower raceway and power house, as well as install a new dynamo. The committee having the matter in hand is composed of Messrs. J. W. Wylie, Andrew Young, and L. W. Chipman.

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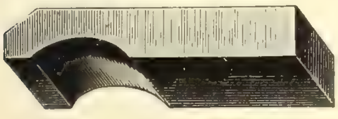
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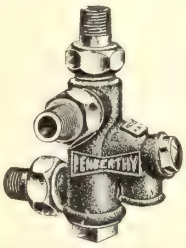

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THE LATE DR. L. S. OILLE.

In the death of Dr. L. S. Oille, which occurred on August 15th, the city of St. Catharines lost one of its citizens who for more than a third of a century had been a prominent figure in public affairs. He was identified throughout a long period with the development of the waterworks system and with the organization of the Board of Trade. He was the chief promotor of the St. Catharines, Merritton and Thorold Street Railway, now the Port Dalhousie, St. Catharines and Thorold Electric Railway. This was for many years operated as a horse car line, but in 1886 it was converted into an electric road, the first in Canada and the second on the American continent. Probably the last great work he accomplished was the building of the old Niagara Central Railway from St. Catharines to Niagara Falls, which is now known as the Niagara, St. Catharines and Toronto Railway. He was possessed of the most indomitable perseverance and no enterprise seemed too great for him to undertake.

The British Columbia Electric Railway Company are building an extension to their car barn at Vancouver.

The Hamilton, Caledonia & Lake Erie Railway Company have purchased a site for a power dam at Indiana, near Cayuga, on the Grand River. The canal will be one mile and a half long.

PERSONAL.

Mr. W. H. Cone, late of Toronto, has been appointed superintendent of the electric and gas plants at Berlin, Ont., which have recently been taken over by the Corporation.

The official announcement has been made of the appointment of Mr. Duncan McDonald to the position of assistant general manager of the Montreal Street Railway and the Montreal Park and Island Railway.

The chief electrician of the Kearsarge, the greatest battleship in the United States navy, is a Bruce county boy, John Kissack, of Paisley. He has written to his friends there giving an account of the visit paid to the vessel by the German Emperor at Kiel, and his impressions of the inquisitive visitor. He has been offered a re-engagement on the Kearsarge, but feels disposed to decline it, as he thinks of devoting himself to electrical engineering.

In view of recent fatal accidents which have occurred in Ottawa in connection with electric wires, it is probable that the city council may engage an expert to examine into and report fully upon the system adopted by the different companies for the transmission of electricity in general, with the object of suggesting such means as may minimize as far as possible the danger of such fatalities or accidents.

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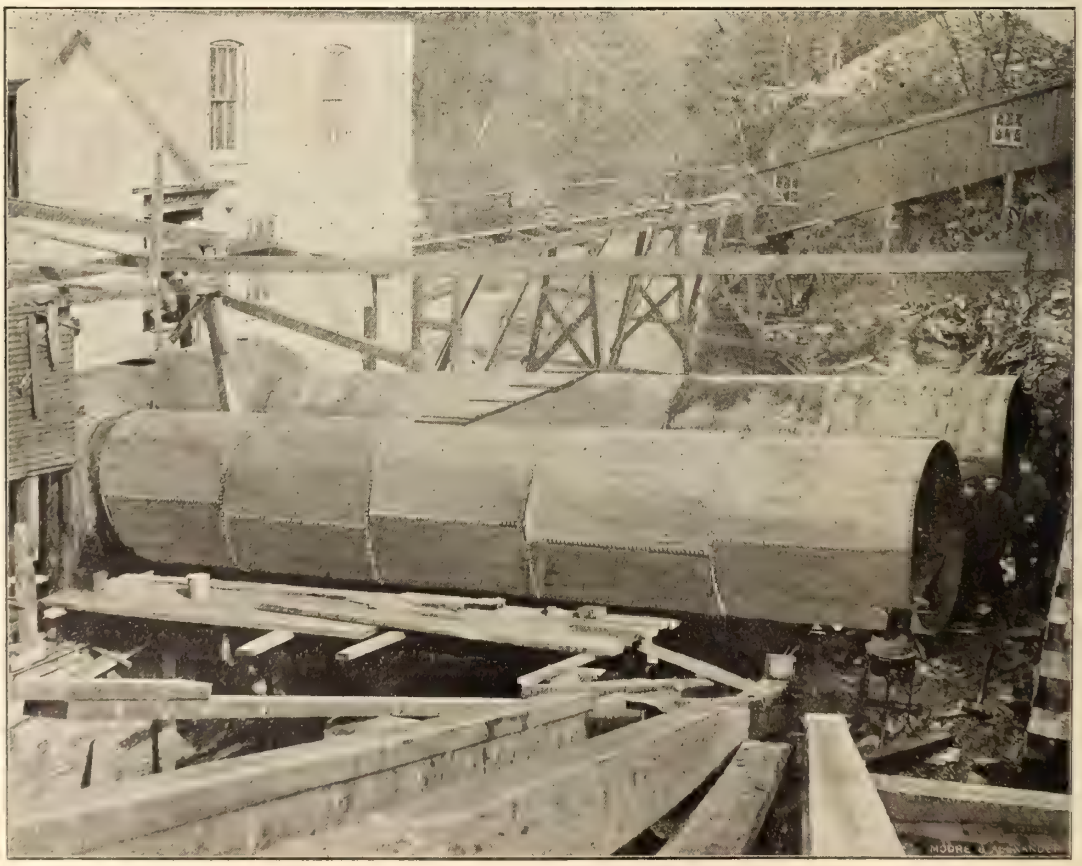

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SPARKS.

A newspaper report states that J. Dodd, late of England, has invented a valveless engine, which is being perfected at the Schaake Machine Works, New Westminster, B.C.

It is stated that negotiations are under way for the control of the street railway of the City of Mexico by the Mexican Light, Heat & Power Company, which is a Canadian corporation.

The Pacific Coast Power Company has been incorporated by the British Columbia Government, to construct a dam and develop a water power on Powell river, in New Westminster district.

Mr. F. H. Clergue, of Sault Ste. Marie, Ont., and the Anglo-American Development Company, Fort William, Ont., are to join forces in the development of the Kakabeka Falls water power. Their proposal is to supply Fort William and Port Arthur with power at $15 per horse power.

A new power company has been incorporated in Montreal, to be known as the Puebla Light & Power Company, Limited. The incorporators are Messrs. E. MacKay and L.S.Colwell, brokers, A. E. Warswick, engineer, John Pinder, merchant, and J. L. Edgar, clerk. The charter gives the company power to carry on the business of an electric light and power company in all its branches and to construct the necessary works for the purpose. It is also permitted to amalgamate with any other company having objects altogether or in part similar to those of this company.

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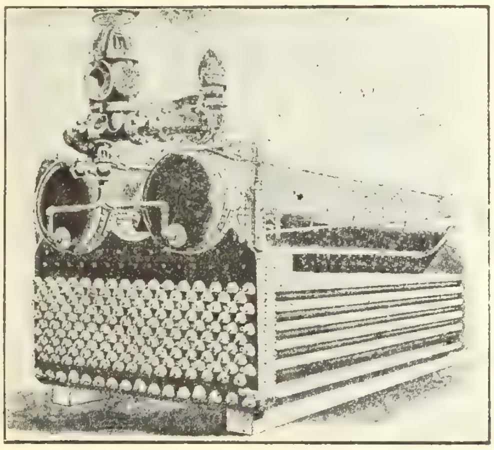

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SPARKS.

The Town Council of Glace Bay, N.S., have appropriated a further sum of $4,000 for extension of electric light plant, to consist of increased boiler capacity and new smoke stack.

The courts having decided that the Montreal Park and Island Railway could not legally build an electric line on the main road of Longue Pointe municipality, to connect with the lines of the Chateauguay and Terminal Railways, the Chateauguay & Northern Railway Company have made the offer to do this work.

The British Columbia Electric Railway Company have just awarded a contract for the erection of a large reduction station at Vancouver, B.C. It will be constructed of steel, stone and cement, and will be 60 × 130 feet and two storeys in height. The equipment will include two switch-boards 50 feet long by 7 feet high, of Vermont blue marble.

The Canadian directors of the Havana Electric Railway Company have been advised that the track is now completed on the Mariano extension, some six miles from the end of the rails as originally laid. Mariano has a population of about 5,000. The rails laid on this section are 90 pounds, and the rolling stock to be used is very fine. The gross earnings of the Havana Electric Railway for 1903 show an average increase per day of $739 over the earnings of 1902.

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SPARKS.

Mr. W. H. Bradt, formerly of the Wallaceburg Electric Light Company, has taken charge of the electric light plant at Tweed.

The Nesbitt Electric Company, of Victoria, B.C., recently assigned to D. H. McDowell.

The business heretofore carried on by E. D. Brand, Berlin, Ont., will hereafter be known as the Berlin Electric Compaty. A full line of electric and combination fixtures will be carried and special attention given to electric wiring of buildings.

The Hinton Electrical Company, of Vancouver, have equipped two tugs belonging to the British Columbia Mills, Timber & Trading Company with search-lights, which will greatly facilitate the towing of logs.

The Huron, Grey & Bruce Electric Railway Company have been granted an extension to their charter permitting the construction and operation of a line from Dungannon to Walkerton and Wingham, and from a point on the boundary between Huron and Middlesex to Sarnia.

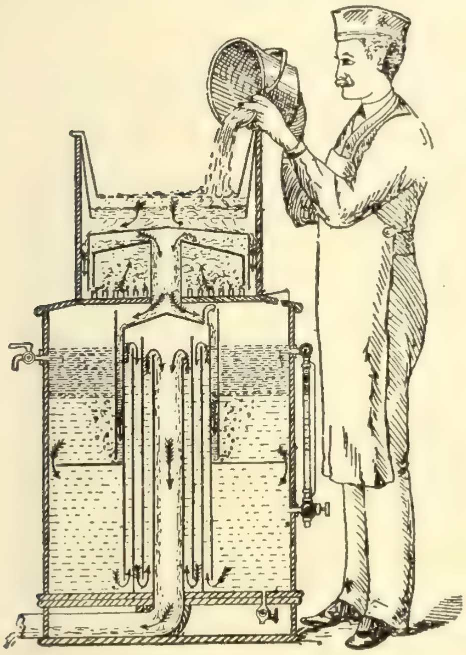

PLATE 2, Sectional View of Filter.

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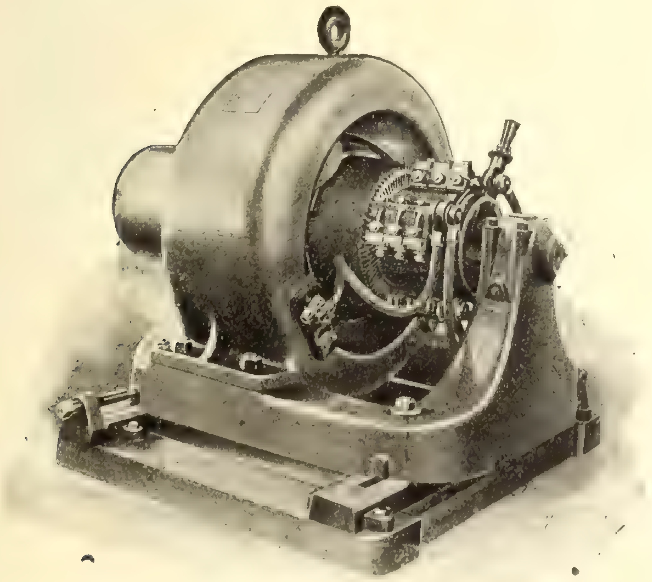

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TRADE NOTES.

If you are not receiving the Pittsburgh Transformer Company's Pretty Girl calendar, don't fail to write for one. These are sent out each month and are not only convenient but very attractive.

The Toronto Exhibition Buildings were lighted during the recent exhibition by Bagnall lamps, supplied to the lighting contractors by the R. E. T. Pringle Company, of Montreal.

The Eugene F. Phillips Electrical Works, Limited, of Montreal, have recently opened an office at 50 Adelaide street west, Toronto, in charge of Mr. J. P. Thompson. This step has been rendered necessary by the increase in the company's business.

The Thos. E. Clark Company have just issued another Bulletin with a full description of their instruments, and valuable information on "Space Telegraphing" by Thos. E. Clark. Send stamp for Bulletin No. 8.

The Thos. E. Clark Wireless Telegraph-Telephone Company, Detroit and Pontaic, Mich., have recently instituted a Wireless Telegraph School for the benefit of those who desire to become familiar with the Clark apparatus. The wireless telegraph field is one with untold possibilities. This school is under the tuitorship of an expert wireless operator, Captain R. W. Holmes. This is a golden opportunity for students to become familiar with the latest electrical apparatus, and also to acquire a knowledge of the instruments which it would be impossible to obtain unless by purchasing the students' sets.

George Stone, a plumber's apprentice, was killed by an electric shock while working at the Collegiate Institute, Ottawa, on August 22nd. He was holding an incandescent lamp looking for leaks in the water service, when by some means a circuit was established.

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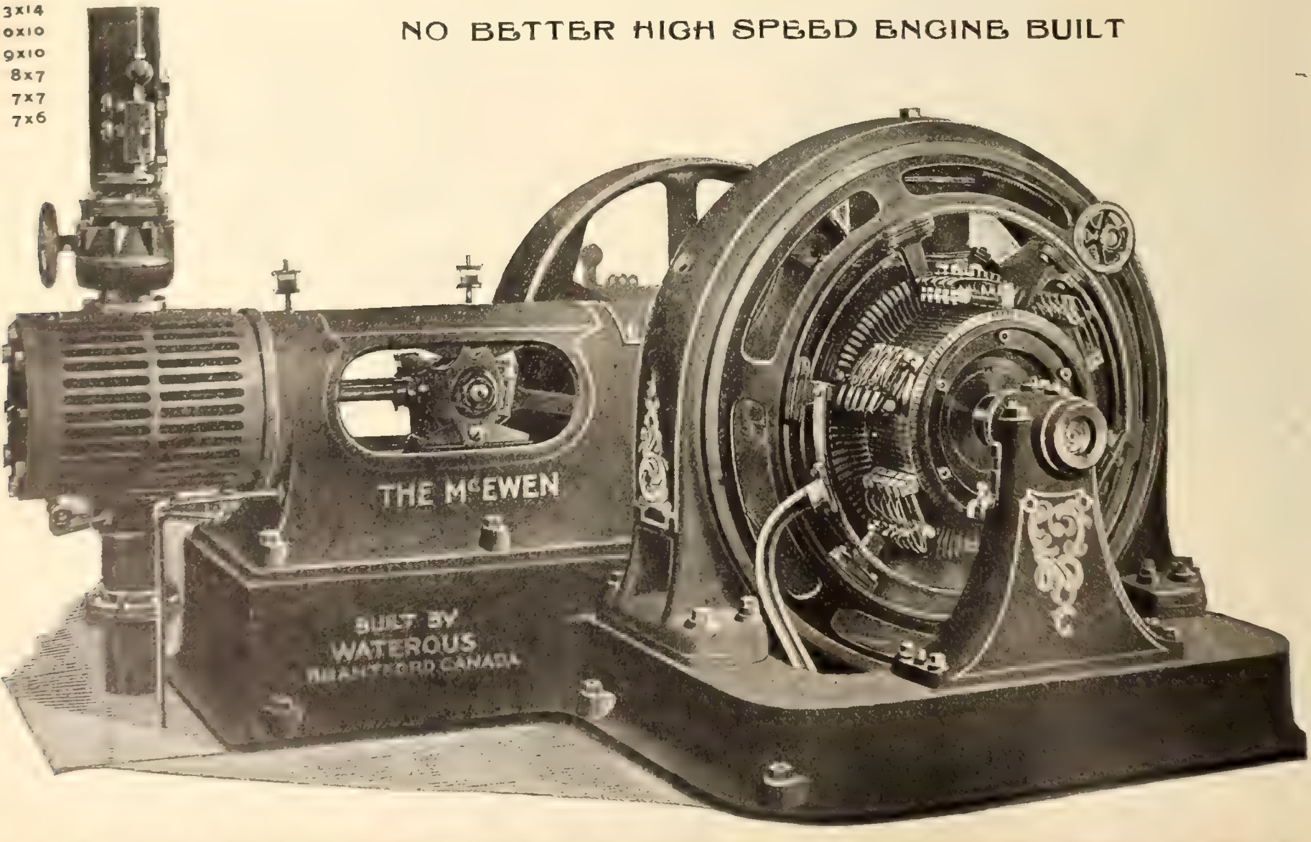

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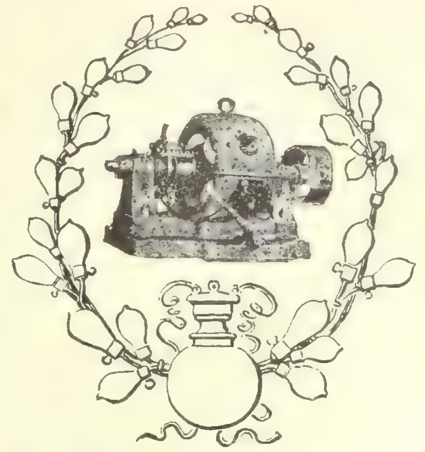
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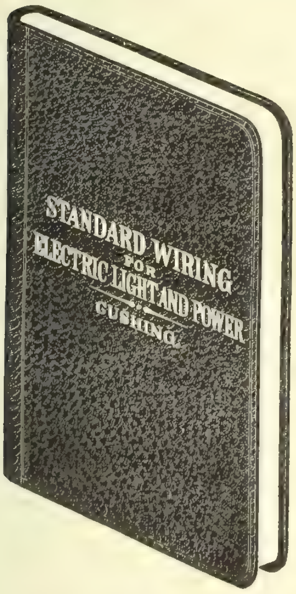

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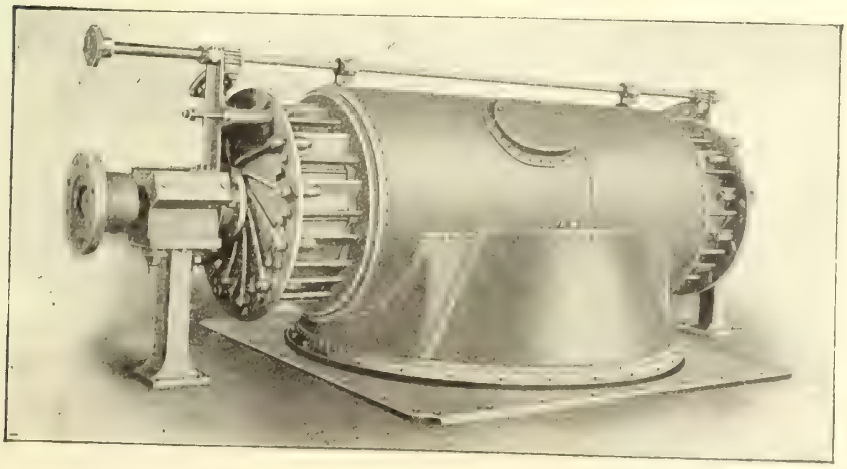
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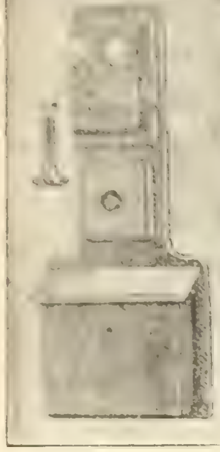

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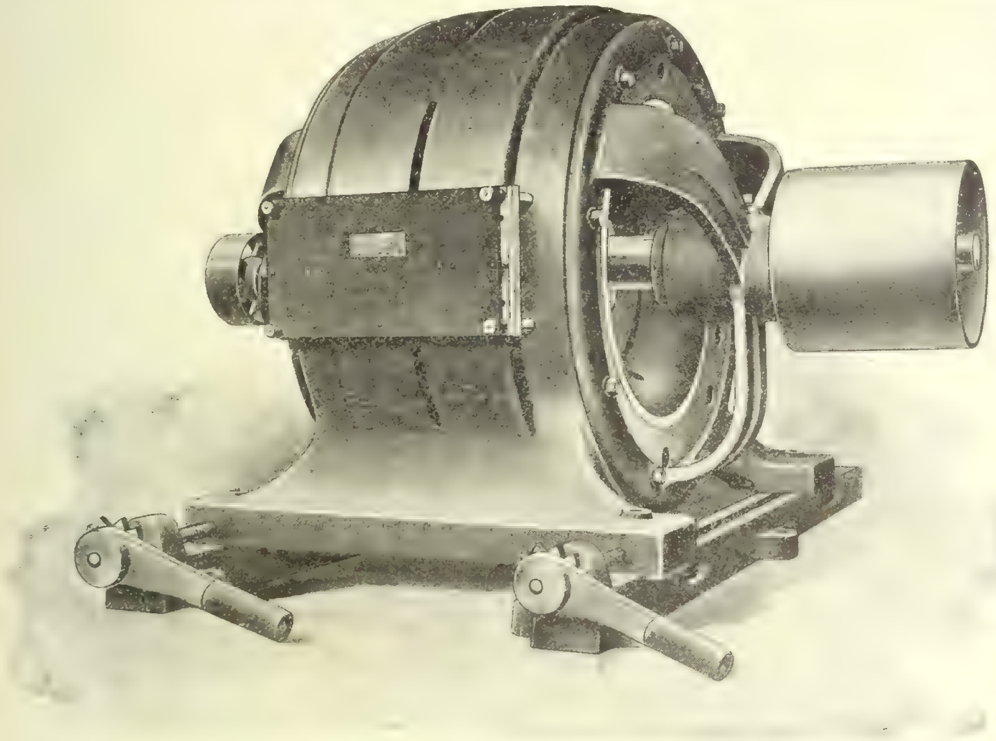

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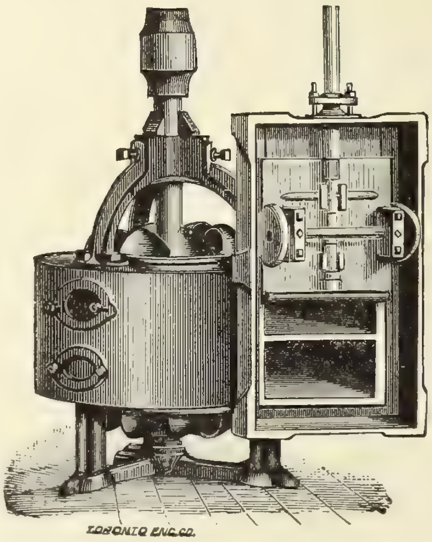

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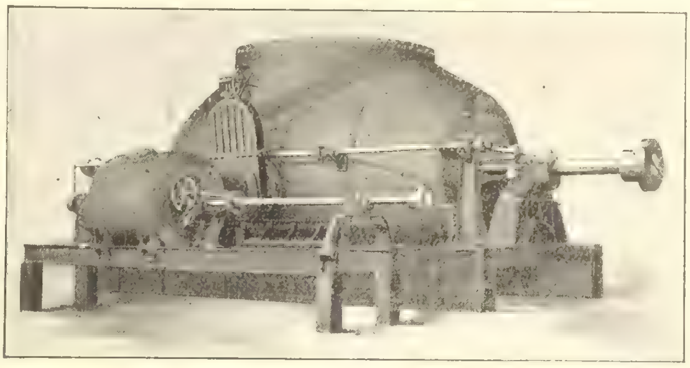

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SPARKS.

The bill of the Ontario & Quebec Power Company has been finally passed by the Dominion Senate.

The citizens of Port Morien, C. B., are agitating for an extension of the electric railway from Glace Bay to that village.

By the casting vote of the mayor, the town council of Windsor Mills, Que., have decided to install a municipal electric light plant.

A proposal has been made that the electric light plant at the Toronto Island be removed to the waterworks station and increased so as to provide light for the entire island.

The Dominion Government have agreed to allow the city of Winnipeg to use the Assiniboine river for power purposes in accordance with a bill recently introduced in the House.

Mr. John T. Wait, of Arnprior, Ont., is about to let the contract for the construction of a concrete dam across the Waba Lac river at that place. Mr. Wait purposes developing the power for electrical purposes.

The Aetna Boiler Inspection & Insurance Company, Sherbrooke, Que., has been organized, with the following board of directors: F. P. Buck, S. W. Jenckes, F. N. McCrea, Sherbrooke; E. W. Tobin, M. P., Bromptonville, Que.; G. R. Smith, M.L.A., Thetford, Que.; C. A. Carrier, Levis, Que.

The "Advantages and Disadvantages of Superheated Steam" were summed up by Mr. W. S. Barston, of New York, at the recent meeting of the National Electric Light Association: Dry steam is obtained in the engine cylinder by superheating 150 degrees, and economy in steam consumption is secured. High quality of pipe covering and well-made valves are required.

Late shipments of "Little Giant" turbines by J. C. Wilson & Company, of Glenora, Ont., include the following: A 12 inch wheel to Thos. Hammond, Hill Head, Que; a 16 inch to A. LeBlanc, Grand Pabos, Que; a 38 inch to Corry & Campbell, Bedford, Que; a 24 inch to the Goldie & McCulloch Co., Galt, Ont; a 28 inch to the Spring & Axle Co., Gananoque, Ont; a 28 inch to W. Knechtel & Son, Hanover, Ont; a 24 inch to Wm. Seigler, Southampton, Ont; a 24 inch to A. Billodeau, St. Patrice de Beaurioage, Que.

The Stouffville, Ont., electric light plant has been completed and is now in running order. The dynamo used is a Royal Stanley S. K. C. 20 k. w. 2-phase, run by a Corliss steam engine of 150 h. p. driving a fly-wheel 12 feet in diameter. The Williams steam boiler used is 71x14. An "S. K. C." switchboard has 2 voltmeters, one direct and one alternating, and 2 ammeters. The building is entirely new, concrete throughout, steel sheeted, and completely fire-proof. The whole plant, steam and electric, was enstalled by Mr. W. E. Barkey, of Tilsonburg, and is jointly owned by Barkey Bros. and Mr. J. Byer. They have a ten-year contract with the town to supply thirty-two incandescent lamps, with street stands and fixtures complete, the intention being to install arc lamps in the future. Mr. Russel Badenach is the chief engineer of the new plant.

Ald. Askwith introduced the following motion in the Ottawa City Council:—"That in view of the many fatal accidents which have occurred recently in Ottawa in connection with electric lighting and the uneasiness thereby created in the public mind, the finance committee is hereby instructed to engage a thoroughly qualified expert to examine into and report fully upon the system adopted by the different companies for the transmission of electricity in general, and in the event of his finding any defects or lack of proper safeguards or precaution, to suggest such means as he may consider necessary to obviate or minimize as far as possible the danger of any such fatalities or accidents recurring."

After a service of over twenty-two years with the Bell Telephone Company in Winnipeg, Mr. Frank Walsh has been compelled to resign his position as district superintendent owing to continued ill-health. Mr. Walsh has been compelled to reside in California during the winter months for the past two years, and as his health has not improved he intends to spend the coming winter there with his family. In his early business life he had charge of the Great North-Western Telegraph Company's office in Winnipeg, leaving their employ to join the Bell Telephone Company in 1881. He installed the first exchange in Winnipeg and the great expansion of the business in that city is due in no small measure to his ability and popularity. Mr. Walsh has been succeeded by Mr. F. C. Patterson, who has managed the company's exchange in Brandon for the past fifteen years.

You would not knowingly burn
your money, would you?

Then why will you use inferior and inefficient power transmission appliances?

Poor transmission machinery is only another fire in which to burn profits.

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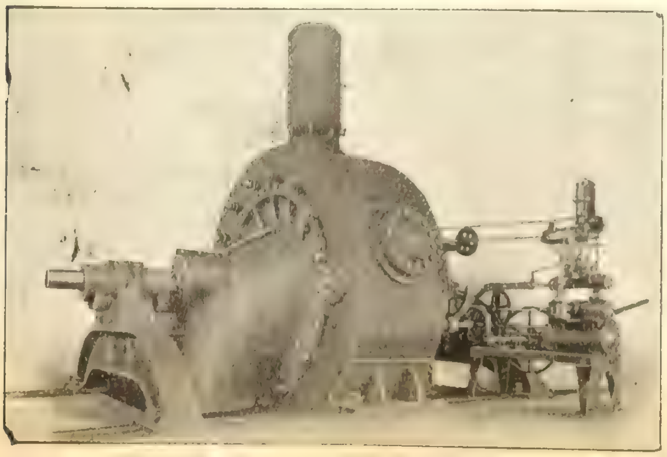
The Samson Turbine

UNEXCELLED FOR USE IN

ELECTRIC LIGHT AND POWER PLANTS



Any Setting—Vertical or Horizontal.

Unequalled in Power, Speed and Efficiency.

BUILT BY

THE WM. HAMILTON MAN'F'G CO., LIMITED

Peterborough, - Ontario

SPARKS.

Mr. M. Continue has purchased Jowett's electric light plant at Bayfield, Ont., and moved it to St. Joseph.

The Westport (Ont.) Electric Light & Milling Company have made arrangements to light the village of Newboro by electric light.

No tenders were received for lighting the streets of the village of Meaford, Ont., and it is likely that an agreement will be entered into with W. Moore & Sons to continue the service on the same terms as existed prior to April 1st, 1903.

The New Brunswick Telephone Company having raised their rates in St. John, Joseph A. McGilton is endeavoring to secure subscribers for a new system. The present rate is $40 for business places and $23 for residences.

Interested persons have recently held several conferences with members of the Ontario Government regarding the development of the water power of the Rainy River at Fort Francis, Ont. It is understood that E. W. Backus, of Minneapolis, and associates, have been given a franchise to develop one-half of the power on the Canadian side of the river, and the prospects for having the power developed in the near future are promising.

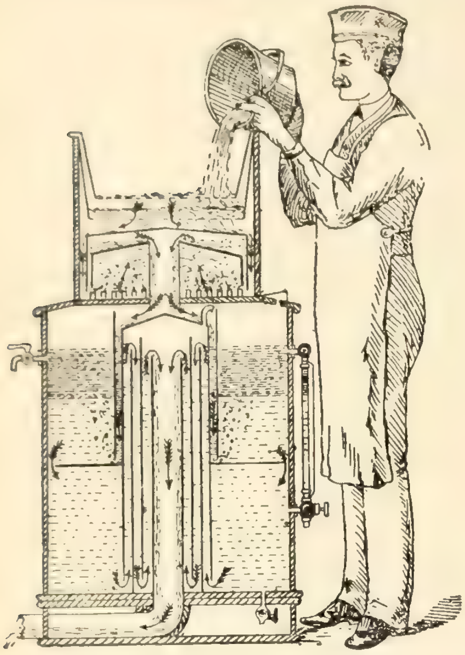


PLATE 2, Sectional View of Filter.

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The Dominion Oil Filter and Extractor

Is the only perfectly Automatic Oil Filter and Extractor known. It depends entirely upon natural laws for the performance of its work. No charcoal or other solid filtering material is used. The simplicity of its construction, coupled with the thoroughness of its work, is a marvel to mechanical engineers. Oil that, ordinarily could be used but once, owing to its dirty and impure condition, is made once again commercially pure, thoroughly free from grit or other contaminating material, and as its lubricating quality has not been impaired it may be used over and over again, thus resulting in an enormous saving in the cost of lubricants.

CYLINDER OIL

By connecting our filter with the drain pipe of your heater you can save 80 per cent. of your cylinder oil.

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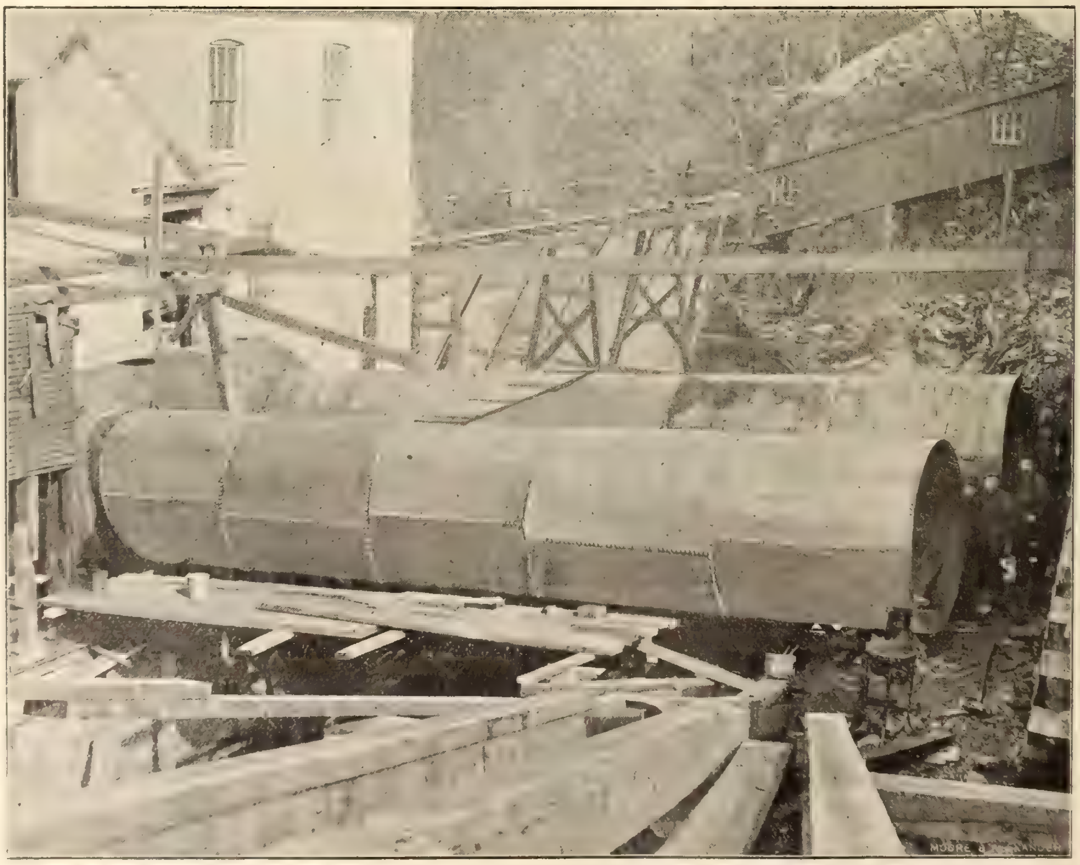
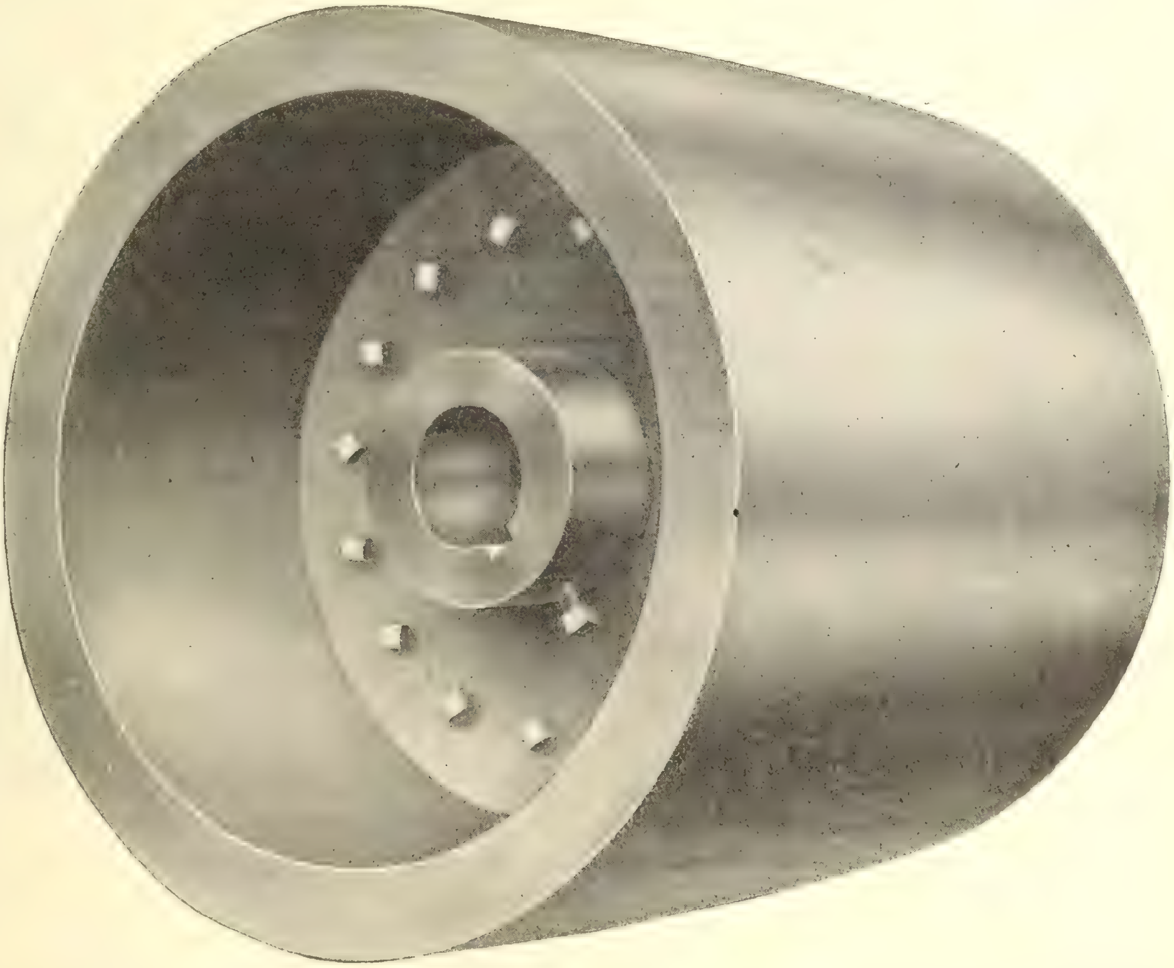


ESTIMATES MADE ON ALL KINDS OF STEEL PLATE WORK.

THE JENCKES MACHINE COMPANY, LIMITED

320 Lansdowne Street, SHERBROOKE, QUEBEC.

XYLOTITE PULLEYS



THE ABOVE PHOTOGRAPH WAS TAKEN FROM ONE OF A LOT OF OUR 52½x56x8 XYLOTITE PULLEYS, WHICH WERE THE LARGEST FIBRE PULLEYS EVER MANUFACTURED.

SPECIFY XYLOTITE PULLEYS ON ALL APPARATUS

WE MAKE ALL SIZES. NONE TOO LARGE OR NONE TOO SMALL.

THE XYLOTITE MFG. CO.

CINCINNATI, OHIO

SPARKS.

The R. E. T. Pringle Company, of Montreal, have been licensed to do business in Ontario.

By a majority of 279 the ratepayers of Guelph, Ont., have voted in favor of acquiring the street railway.

The headquarters of the Canadian Bullock Electrical & Manufacturing Company are now located in the Coristine Building in Montreal.

The corporation of Gravenhurst, Ont., have finally taken over the electric light plant, which will be under the management of Mr. Ed. Fletcher.

Messrs. H. Brown & Sons, of Carleton Place, Ont., are now engaged in building a new tail-race with a view to improving the water power, and next spring purpose building a new power house.

At the request of the city council of Sherbrooke, Que., the Sherbrooke Power, Light & Heat Company have decided to extend the street lighting contract for one year from July 1st, 1904.

The Eugene F. Phillips Electrical Works, of Montreal, have received a license to do business in Ontario, with a capital of $30,000. Their office is at 48 Adelaide street west, Toronto, and is in charge of Mr. James P. Thompson.

The King Edward Oil Company, Limited, has been granted an Ontario charter, with head office at London, Ont., and a share capital of $100,000. The provisional directors are James R. McDowall, D. S. Robb, James Houlden, James Hutcheon and Samuel Howard.

The Jenckes Machine Company, of Sherbrooke, Que., are erecting temporary shops at Chippewa, Ont., to be used during work on the large flume for the Ontario Power Company. This flume will have a total length of 5,880 feet and will be 18 feet in diameter. The steel will be ½ inch thick and will be reinforced by heavy steel hoops. About 200 tons of rivets will be used.

The Toronto Railway Company are making large improvements to their plant in order to increase the amount of power available. Six new boilers of a total capacity of 3,600 horse power, two engines of 1,600 horse power each, directly connected to two generators, and a large storage battery, are being installed. The company is also constructing over forty miles of new feed wires, which will be of extra heavy construction, so as to distribute the power more easily.

It is rumored that steps are to be taken to resume operations on the works of the Metropolitan Electric Company at Ottawa. An examination of the works was recently made by Mr. John Kennedy, C.E., of Montreal. It will be remembered that a few years ago the Metropolitan Company secured a franchise for the supply of light, heat and power throughout the city of Ottawa. After considerable money had been spent in the construction of a power canal at Britannia, the project was abandoned.

Mr. R. S. Kelsch, E.E., of Montreal, has submitted to the city council of Ottawa a report on the establishment of an electric plant for street lighting, the present contract with the Ottawa Electric Company expiring in May next. His proposal is to erect a distributing station at the rear of the city hall, at a cost of $5,000. The equipment would cost $28,800. The electric wires, cross-arms, hangers, etc., now on the streets would be utilized, Mr. Kelsch considering that a fair price for same, if new, would be $11,500. This would mean that the complete plant could be secured for $40,000. The cost of operating is estimated at $19,900 a year. This includes the purchase of power at $16 per apparent horse power, and also depreciation of plant, which is so estimated so as to provide for an entire renewal in twelve years. Upon this basis the cost per lamp is placed at $42 per year, as compared with the present contract price of $65. The committee has recommended that a by-law be submitted to the ratepayers in January next authorizing the raising of $50,000 for the purpose.

Direct Connected Generators
For Railway, Lighting and Power

Belt Driven Generators

Multi Voltage System
For Variable Speed Control.

Crane Motors and Controllers

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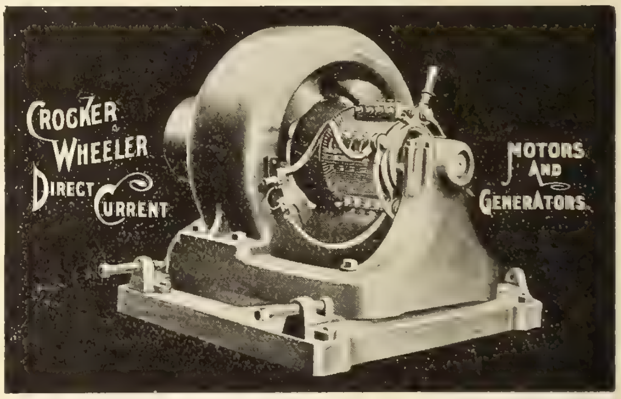

The Pretty Girl calendars are distributed every month. If you don't get these regularly send us your name for our mailing list. At the same time you might as well state when you will need more transformers. Then when you do order, think of Pittsburgh and send your order to us.

Pittsburgh Transformer Company

The R. E. T. Pringle Company, Limited,
Sales Agents

Westinghouse
Integrating Wattmeters

The Recognized Standards

- Accurate for years without cleaning or recalibration
- Accurate on inductive loads of any power factor
- Will carry continuous overloads of fifty per cent.
- Will carry temporary overloads of one hundred per cent.

Two-Wire Single Phase Metal Covered.

For Particulars Address

Ahearn & Soper Limited
Ottawa, Canada.

The Lighting Season is now at hand

and the shorter days must be lengthened by the provision of artificial light. The most economical and satisfactory manner of procuring the maximum of light from a given amount of power is by using Packard Lamps.

Every lamp is thoroughly tested before it is shipped so that it is fully up to its rated candle power and mechanically as perfect as human skill can make a lamp. In service the Packard lamp gives the most light and lasts the longest.

Our lamp booklet tells why. Send for it.

The Packard Electric Co. Limited
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DYNAMO AND MOTOR REPAIRS

All types of Dynamos, Motors, Transformers and Arc Lamps repaired and rewound by : : :

COLLYER & BROCK

in their new factory, especially equipped for this class of work at : : : : : : :

Telephone M. 1930

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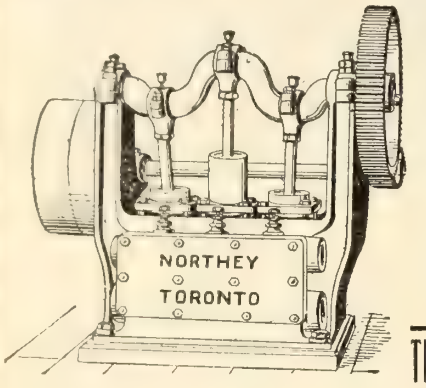
Write for quotations and further particulars.

THE NORTHEY TRIPLEX POWER PUMP



This pump excels in high class materials and workmanship. A practically constant delivery is assured by the three cranks being placed 120 degrees apart. The pump can be operated conveniently by water power—by belt from engine or by electricity.

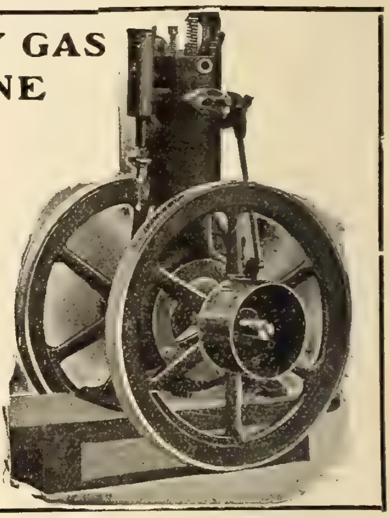
We manufacture pumps of every description—for all purposes. Our pumps are standard in Canada for excellent service.

Write for Catalogues.

The NORTHEY GAS AND GASOLINE ENGINE

The Northey Gasoline Engine offers the best proposition in the market for cheap, easily handled power. The Engine runs with practically no attention—any boy can manage it—running expenses very light. Ready for work on the minute. Suitable for running independent electric light plants—pumping and elevator plants, etc. This cut illustrates the ½ H. P. size—the only vertical style built; all other sizes are horizontal.

Write for Booklet.



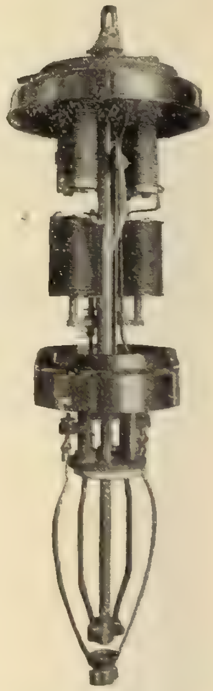
THE NORTHEY CO., LIMITED, 970 King Street Subway TORONTO.

New Helios-Upton Arc Lamps

HAVE
- Simplicity of mechanism.
- Every portion easily accessible by removing outside case.
- Upper carbon holder has an outside cable connection.
- Large inner globe supported from the bottom.
- Porcelain lined inner globe cap.
- Most durable form of resistance.
- Easily trimmed.
- Easily adjusted.
- Steady burner.

JOHN FORMAN

708-710 Craig Street, Montreal



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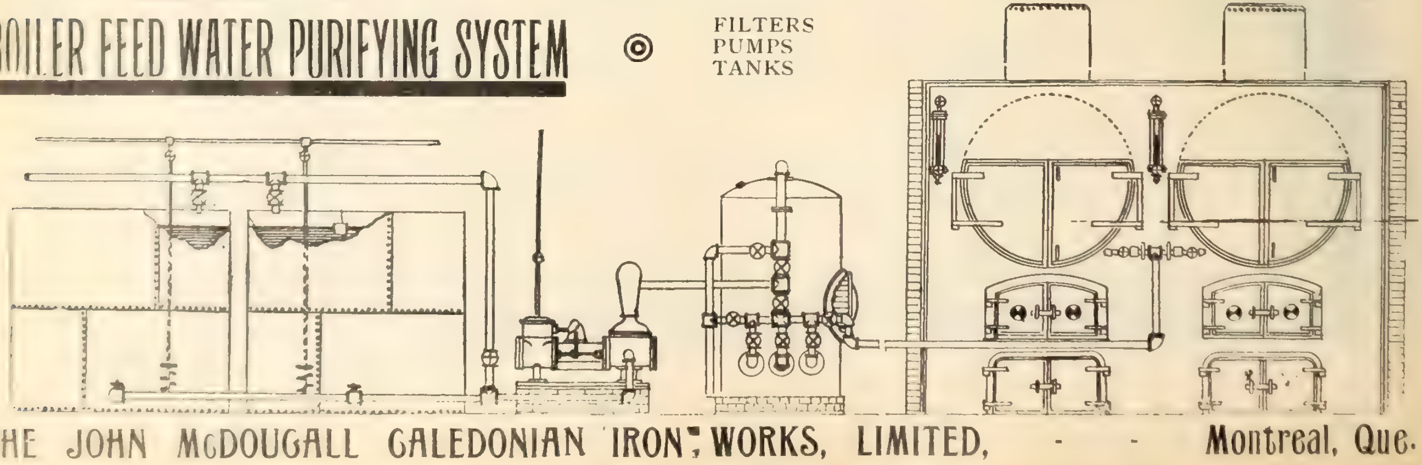
◎ FILTERS
PUMPS
TANKS



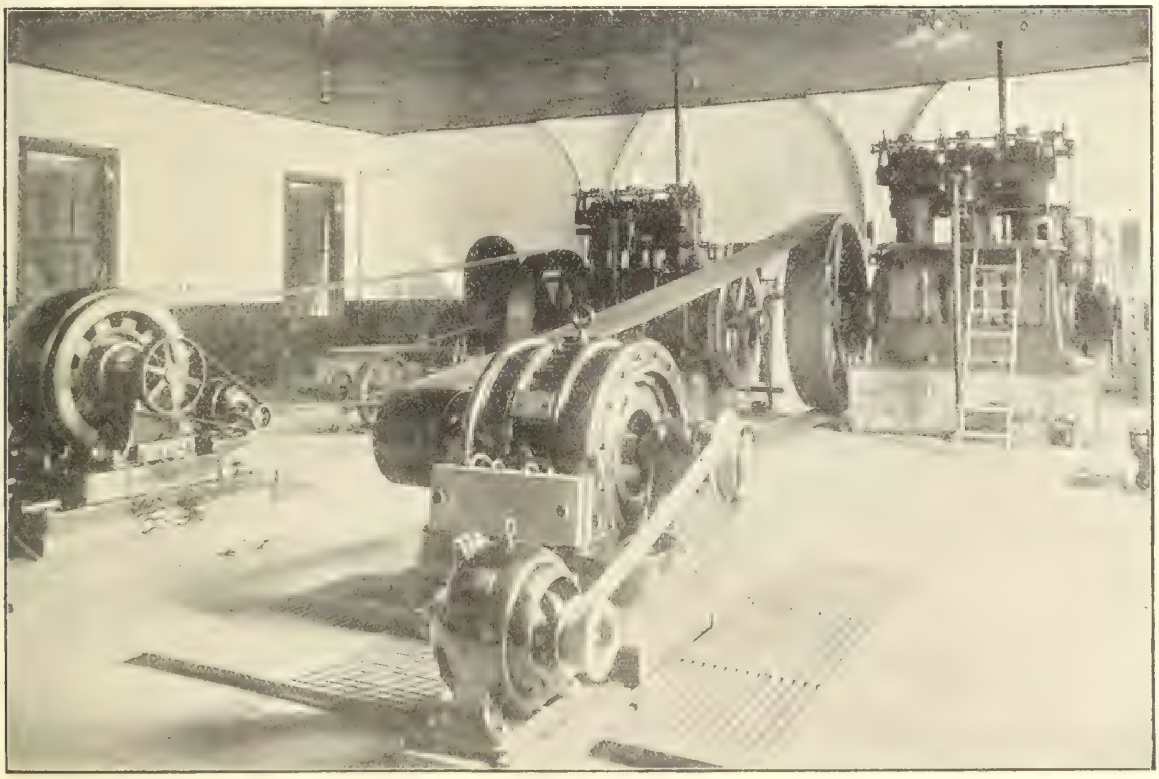
THE JOHN McDOUGALL CALEDONIAN IRON WORKS, LIMITED, - - Montreal, Que.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. OCTOBER, 1903 No. 10.

COMBINING GAS AND ELECTRICITY.

A visit by our representative to Chatham to see the new plant recently installed by the Chatham Gas Company will be of interest to our readers. Gas engines are used as motive power for the electric plant and are the first to be installed in Canada by a gas company operating an electric lighting plant and using artificial gas for engines. This company does commercial lighting only, as the city own a municipal lighting plant.



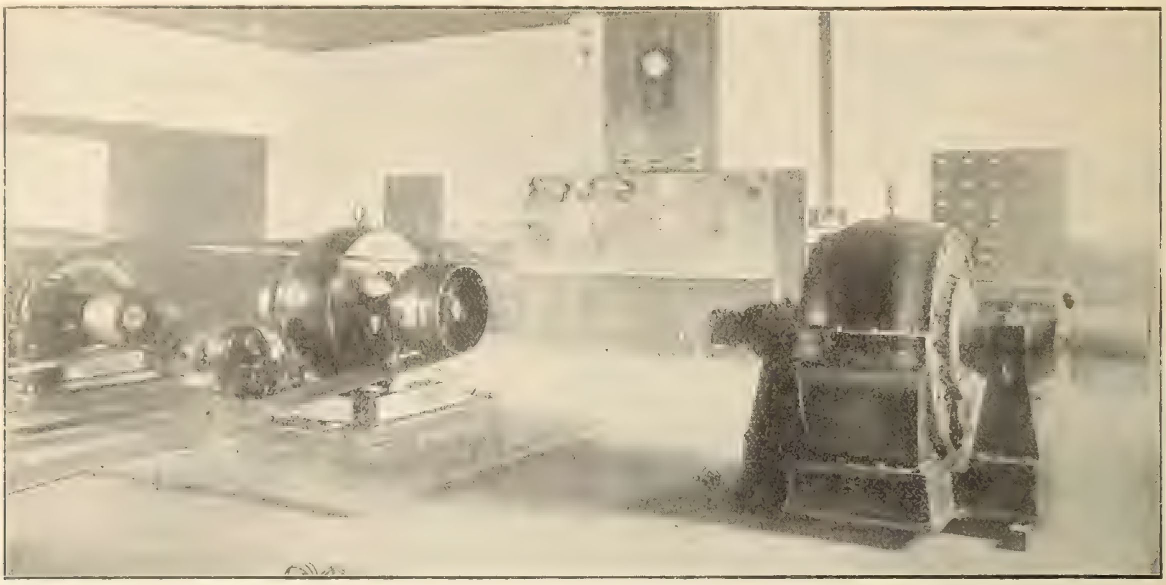
The Chatham Gas Company—View of Power House Looking Toward Gas Engine.

The buildings, shown on the following page, are two-storey, of pressed brick and stone, and present a fine appearance. They stand in the centre of three acres of land. The company have six thousand lights wired up in the city and business is rapidly increasing. They operate gas, arc, and incandescent lighting, the tendency being more towards electric lighting, the gas being used principally for heating and cooking, and costing one dollar per thousand feet.

The arrangement of the company's plants, from rear on river bank to King street front, is exceedingly good. Upon the river bank at the rear are the wharves and steam coal hoisting plant. Coal is freighted by water from Cleveland, Toledo and other ports, conveyed into sheds immediately at the rear of the retort house of the gas works ; it is elevated to the charging floor of retort house seven feet in height by a ten h.p. gas engine, manufactured by the Coldie & McCulloch Company, of Galt.

The retort house, coming next in order, contains four benches of six retorts each, with capacity for making gas of 220,000 cubic feet per day, the company's present output being 90,000 feet. The gas benches are modern type half-depth regenerative, made by the Jas. Gardiner, jr., Company, of Pittsburg, and are very satisfactory in operation. Next in order comes the condensing plant of the gas works. This room contains the latest type of condensing and scrubbing, tar and ammonia extracting apparatus, with a capacity of 300,000 cubic feet daily and recently installed by the Economical Gas Apparatus Construction Company, of Toronto. The next room contains purifiers, station meter and governor for gas works, and also a small gasholder of a capacity of 15,000 cubic feet, which is used entirely for storage for gas engines. This holder is connected and may be filled either from the retorts direct or from the larger gasholder used for supplying the public.

In the electric power house two Westinghouse gas engines are installed, one of 125 horse power, the other of 85 horse power, also one S.K.C. single-phase alternating generator of 80 k.w., 1000 revolutions, and one Warren single-phase alternator of 60 k.w., 800 r.p.m. The engine-room is 60 x 45 feet.



THE CHATHAM GAS COMPANY—VIEW OF POWER HOUSE, LOOKING FROM GAS ENGINE TOWARD SWITCHBOARD.

The switchboard contains four panels, with three ammeters, three voltmeters, and three ground detectors, all of the Whitney type. Westinghouse lightning arresters are also installed. Space is reserved in this building for the installation of another engine next summer. At the rear of the coal sheds is an auxiliary steam plant held in reserve, in which are installed a 150 horse power automatic high-speed engine, made by Armington & Sims, driving an 80 k.w. Royal Electric generator, and a 50 horse power high-speed engine of the same make drives a 30 k.w. dynamo.

The gas engines are started by compressed air. The tanks are kept at a pressure of 200 lbs. and are filled by a Westinghouse air pump. The air tanks are connected to a cylinder of each engine and the cylinder acts as an air motor for starting the engine.

Both the gas and electric plants have been erected completely new within the past two years, and with a view to future extensions. The company owns extensive properties on each side of the works; both the gas engine electric plant and the retort room of the gas works are arranged for tripling the capacities of each, if necessary.

THE CHATHAM GAS COMPANY—OFFICE BUILDING.

Coal enters the rear end of the building and is transformed into electric power in one continuous operation—from the coal sheds to retort room, there transformed into gas and taken to the gas-holder, from the gas-holder to the gas engines, from the engines power is delivered to the generators, and from the generators to the public.

In conversation with the obliging manager he said the advantages of gas engines as motive power for gas companies operating electric plants were: No more coal required for gas engines than for steam for equal amount of power; the by-products of coal obtained after gas is produced, namely coke, tar and ammonical liquor, very largely reduce the cost of the coal; gas engines require no fireman—one engineer can operate a number of engines; cost of maintenance is very largely reduced; no repairs for steam pumps, condensers, furnaces, grate bars, boilers, etc., nothing but ordinary repairs to engines themselves, which would not be more than steam engines of equal power; practically no danger from fire, there being no fire of any kind in gas engine plant; engines are ready to start up at a moment's notice at any time, starting by compressed air.

THE CHATHAM GAS COMPANY—ELECTRIC POWER HOUSE AND GAS WORKS.

The offices are on the second floor of the main building, the lower floor being used for workroom and storage of supplies.

The company has its own teams for delivering coke, selling largely to the public for furnaces, stoves, ranges, grates, etc.

They keep a large force of wiremen, contract for electric wiring both in the city and outside, sell electric supplies to neighboring towns, etc.; install gas lamps of all kinds, as well as gas ranges and heaters, etc.

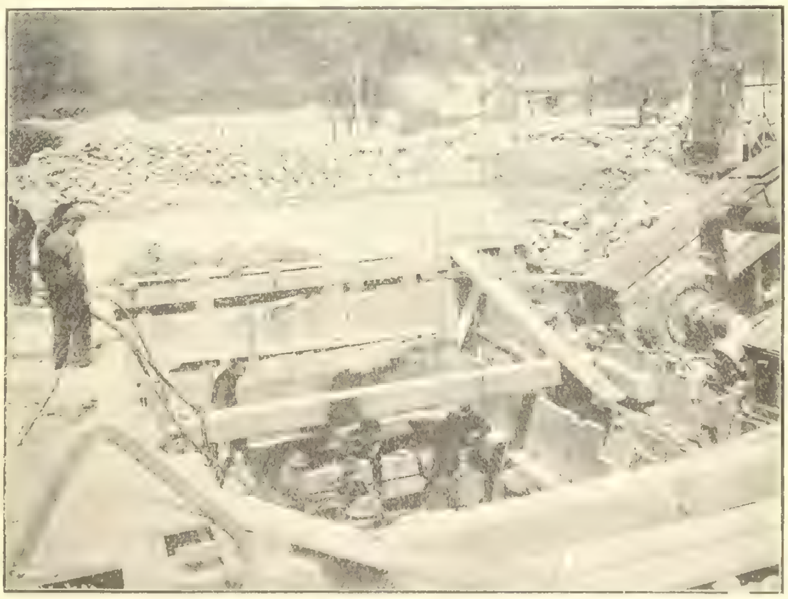
The company's officers are composed as follows: William Ball, president; Manson Cambpell, vice-president; P. S. Coate, manager and secretary-treasurer.

The Electrical Development Company of Ontario—View Showing the Progress on Crib Cofferdam.

ELECTRICAL DEVELOPMENT COMPANY OF ONTARIO, LIMITED.

Of the three Canadian companies now engaged in the development of the mighty power of the Niagara, the plans upon which the work of the Electrical Development Company of Ontario, Limited, is proceeding are perhaps the boldest and most original. This company, which is composed of Toronto capitalists, secured their charter only last February, but no time was lost, and within two months the work was under way. By agreement the company will dispose of their electric energy to the Toronto and Niagara Power Company, who are constructing the necessary pole line from the Falls to Toronto. It is proposed to develop 125,000 horse power, the location being a little above that of the Canadian Niagara Power Company, in the Queen Victoria Niagara Falls Park. The rapid progress that has been made is shown by the accompanying illustrations from photographs taken by the company late in September and loaned to the Electrical News for publication.

The Electrical Development Company of Ontario—View from Rock in River, Showing Cascade and Launching of Crib.



The Electrical Development Company of Ontario—View Showing Protective Work at Mouth of Shaft of Tail-Race Tunnel.

The first cut forms a panoramic view showing the progress on the crib coffer dam. The second illustration is an exceedingly good one, showing the cascade and launching of crib, and gives a splendid idea of the magnitude of the work. In the last view is seen a good deal of detail and particularly the protective work at the mouth of the construction shaft of the tail-race tunnel.

The features of the development include a large dam, wheel-pit and tail-race tunnel. A cofferdam of crib work was built to shut off the water. Of the main dam 1276 lineal feet had been constructed by September 30th. This dam is built out into the river at an angle of perhaps 40 degrees with the shore. It is of timber cribbing, with rock filling and water-proofed clay puddling. It will average about twenty-five feet in height, perhaps 8 to 10 feet above the surface of the water.

A few weeks ago the current at one point was so heavy that the contractors had a fender constructed as a protection to the dam. This was made of the heaviest square timber, in triangular form, and was anchored at the danger point by a one-inch twisted steel wire cable. Shortly after it was placed in position the cable snapped like a silk thread, the fender was dashed down the current, and whirled into the eddy beyond the dam. To bring it back against the stream was impossible, so a new fender was built, drifted down to position and anchored by stronger cables, which are held in place by the aid of a donkey engine in constant operation.

The wheel-pit, for which Mr. M. P. Davis, of Cornwall and Ottawa, has the contract, will be 416 feet long, 160 feet deep, and 22 feet wide. Ten steel penstocks will carry the water from the intake to the turbines, and as the pressure at the bottom carried by the 160-foot fall of a ten-foot cylinder of water is over 400 tons, the penstocks, the wheels, and indeed the whole work must necessarily be of an exceptionally heavy character. The preparatory work for the excavation of the wheel-pit is now under way.

Mr. Anthony C. Douglas, who is building the tunnel of the Canadian Niagara Power Company, is also building the tunnel of the Electrical Development Company. Whereas the tunnel of the Canadian Company runs underground, that of the Electrical Development Company will run under water. In other words, it will be for its whole length 160 feet below the bed of the Niagara river, and its mouth will be in the very heart of the Horseshoe Falls. This tunnel will be 2,200 feet long from wheel-pit to discharge, 24 feet wide and 28 feet high. The preliminary shaft has already been sunk to a depth of 150 feet. From the bottom of this shaft there will be built a lateral tunnel 8x15 feet, extending out under the river bed about 650 feet to the line of the main tunnel. From this junction point headings will be driven up and down stream in the construction of the main tunnel. One disadvantage of this form of tunnel is that work cannot be begun from both ends. It may begin, however, at the intersection of the tunnel line with the construction drift at the same time as it begins at the wheel-pit. However, Contractor Douglas has executed the work with great dispatch, having made a record in the sinking of the shaft. The tunnel is being drilled by compressed air drills, and when completed it will be timbered and lined with concrete and brick, a necessary precaution when water is driving through at a rate of twenty-five feet a second.

A NOVA SCOTIAN ELECTRIC PLANT.

The new electric light plant of the town of Liverpool, N.S., consists of an hydraulic development, with earth and gravel dams, diverting the water of the main river at Liverpool through a natural swale. The water thus diverted is sufficient to develop a maximum of 1,900 h.p., under a working head of twenty-two feet.

There are two retaining dams; one acting as a wing dam to the other. At the junction of the two dams mentioned there will be a large wooden flume connecting the water to the turbine settings, which are of the open type.

The Jenckes Machine Company have the contract for a pair of 40-inch wheels, both inclosed in one casing, developing 755 h.p., under 22 feet head of water, at 168 revolutions per minute. Provision is being made for the future installation of two similar settings.

The electrical contract has been awarded to the Canadian Bullock Electric Manufacturing Company, and will consist of two 225 K.W. A.C. 2-phase generators. Provision will also be made for the future installation of four similar machines. The contract also embraces line construction into the town of Liverpool.

This plant is under municipal control and will cost about $50,000. It is calculated to deliver light and power to Liverpool and surrounding territory.

Both the hydraulic and electric work of the plant is being engineered by the Maritime Electric Company, of Halifax, of which Mr. G. C. Siebert is manager. It is expected that this plant will be in operation this fall.

To find the load which a given pair of engines will start: Multiply the area of one cylinder by the pressure of steam and twice the length of stroke. Divide the result by the circumference of the drum, and deduct one-third (say) for friction.

FIRST ANNUAL FIELD DAY.

The office employees of the Canadian General Electric Company and the Canada Foundry Company, Toronto, held their First Annual Field Day on Saturday afternoon, October 3rd. The Toronto Lacrosse Grounds in Rosedale were engaged for the occasion. The games were well contested and held the interest of the spectators throughout. Universal satisfaction was expressed at the way the events were run off, everything going along without a hitch, owing to the very efficient handling by the Executive Committee. The prizes were distributed at the works offices of the Canada Foundry Company by the Assistant Superintendent, Mr. A. C. MacCallum, and at the head office by the Comptroller, on October 8th.

The Executive Committee having charge of the arrangements was composed of Messrs. A. Oakley (chairman), A. W. Roberts (secretary treasurer), H. G. Nicholls, E. D. McCormack, William McCaffery, Norman McLeod, E. Wedd, K. L. Aitken, and Charles Oakley.

The Field Officials were: Referree, Mr. George W. Watts; Judges of Track Events, Messrs. H. G. Nicholls and Charles Oakley; Judges of Field Events, Messrs. J. J. Ashworth and G. Boyd; Starter, Mr. A. Oakley; Scorers, Messrs. Walter Nicholls and A. R. Leicester; Clerk of the Course, Mr. R. T. Mackeen.

The winners in the different events are given below:

1. 100 yards Dash, 16 and under: (1) Norman Richards; (2) Harold Williamson; (3) Bert Gould.
2. Sack Race: (1) J. H. Harris; (2) J. M. Oxley.
3. 100 yards Dash: (1) Wm. McCaffrey; (2) Ernest Kerrigan.
4. 220 yards Race, 18 and under: (1) Harry Robertson; (2) Frank Mulhall; (3) W. Cartwright.
5. Bicycle Race, 1 mile: (1) H. Dennison; (2) J. H. Harris.
6. Throwing Baseball: (1) E. Trowbridge; (2) K. W. Tandy.
7. Hurdle Race: (1) H. Dennison; (2) Wm. McCaffrey.
8. Putting 16 pound Shot: (1) J. Glubeland; (2) W. Nicholls.
9. Three-Legged Race, 100 yards: (1) F. Patterson and H. Philpot; (2) F. Regan and J. H. Harris.
10. Running High Jump: (1) Ernest Kerrigan; (2) K. L. Aitken.
11. One Mile Race: (1) G. L. MacGillivray; (2) J. M. Oxley.
12. Running Broad Jump: (1) H. H. MacFayden; (2) K. L. Aitken.
13. 440 yards Race: (1) Harry Robertson; (2) L. O. Horner.
14. Married Men's Race, 100 yards: (1) Ed. McCormack; (2) T. Porter.
15. Running Hop-Step-and-Jump: (1) H. H. MacFayden.
16. Department Relay Race, One Mile: (1) Accounting Department: H. Robertson, H. MacFayden and F. Mulhall.

Gold Medal for Championship: Wm. McCaffrey.

NEW AUTOMATIC SWITCH.

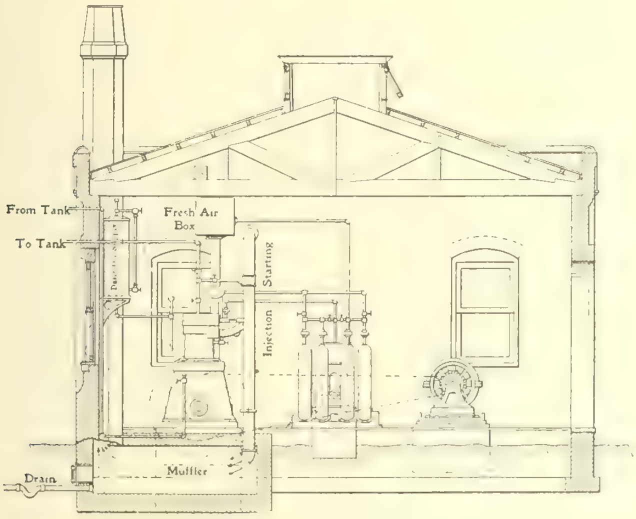
The Toronto Railway Company are experimenting with a magnetic switch which is expected to obviate the necessity of employing men at the junctions of streets, and also make it unnecessary for the motorman to turn the switch at any point. The switch is manufactured by the Baldwin & Rowland Switch Company, of South Norwalk, Conn., and is said to be in operation in many large cities in the United States. The switch turns itself, its automatic action being caused by magnetism. At the north end of the switch point a system of magnets has been put in under a heavy iron plate. Below the magnets about ten feet of the outside rail of the track is "dead," having no current through it. When the switch is turned against him the motorman stops his car just in front of the "dead" rail. As the car wheel touches the "dead" rail when the car moves again, a current is sent through the rail and the magnets are disturbed, causing the switch to move to the desired position.

OIL ENGINE CENTRAL STATION.

A radical departure from existing central station plants is afforded by the new electric light plant at Jewett City, Conn., a town of about 3,000 inhabitants. The new plant, which was started about the middle of July, has the distinction of being the first central station in the United States to adopt the Diesel oil-burning engine as its source of motive power, and represents an interesting example of elimination—no boilers, stacks, coal bins, stokers, economizers, or heaters being necessary. Compactness is the key-note of the whole design. Until the new plant was started, Jewett City was lighted electrically by a 60-k.w. Westinghouse 2,200-volt 60-cycle single-phase alternator driven by water-power at the Aspenock Bleachery. The claims made for the Diesel engine convinced the town authorities that a new station could be operated with profit, and the result, says H.S. Knowlton, in the American Electrician, represents one of the most advanced types of small lighting plants to be found in the East.

The power station is located on the west bank of the Pachaug River. A small brick chimney about 8 ft. high carries away the products of combustion discharged from the engine cylinders; before entering the chimney, the exhaust gases pass through a muffler.

The oil supply for the engine is drawn from two storage tanks set underground near the station. Their combined capacity is 6,500 gallons. The oil, which is crude, is brought to the plant in tank wagons holding 640 gallons, and costs 4·6 cents per gallon delivered. It is pumped from the main tanks to a vertical tank holding 40 gallons, and from this tank it is supplied to the engines.



Cross-Section View of Generating Room.

The generating plant consists of two 60-k.w. Westinghouse single-phase 2,200-volt 60-cycle alternators, belt-driven by two 75-b.h.p. triple-cylinder Diesel oil engines, of the vertical marine type. The engine cylinders are all 15 in. stroke and 10 in. diameter. The i.h.p. of each engine is about 100.

The engines constitute the most interesting feature of the plant and were built for the American Diesel Engine Co., of New York, by the International Power Co., of Providence, R. I. They operate on the well-known Otto cycle of admission, compression, combustion, expansion and exhaust, but differ radically from ordinary gas and oil engines in the character of the combustion. This is not of explosive character, but is steady combustion at high compression temperatures. During the compression stroke the cylinder contains air only, and the temperature due to compression ignites the combustible charge without the need of electric spark or ignition tube apparatus. The clearance is about 7 per cent. of the cylinder volume, and the combustion of the vaporized oil does not increase the pressure caused by the compression. The cylinders are symmetrically mounted on the engine housing and drive a single shaft through cranks having 120% displacement.

The valve operating cams are on the usual secondary shaft driven by the main shaft through an intermediate gear. The admission and exhaust valves are driven by two of these cams. The movement of the admission valve particularly is very slight. The oil is driven into the cylinders by compressed air through a series of perforated brass washers, and enters the cylinders in the form of a fine spray; an auxiliary air compressor, driven by belt from the engine, supplies the air for this purpose. The air which supports the combustion is drawn into the cylinder through an automatic mushroom valve, and is compressed on the up stroke to between 450 and 525 lbs. pressure per square inch, corresponding to a temperature of about 1,000% Fahr. The fuel valve is open for about one-tenth of the working stroke, and the fuel is let in and consumed during the whole or a part of this period as determined by the action of the governor. At the termination of the fuel supply, the resulting gases of combustion work expansively during the remainder of the stroke. The combustion is singularly complete on account of the large quantity of oxygen in the cylinder at the beginning of the working stroke. Any grade of crude or fuel oil may be employed in the engine.

The fuel oil is delivered to the fuel-admission valve by a pump driven from the cam shaft. One pump cylinder is provided for each of the main cylinders, and behind each is a by-pass valve, which, when open, allows the oil to flow again to the suction side of the pump instead of to the fuel valves. The length of time that these by-pass valves are open is controlled by the governor, which is of the centrifugal "Begtrup" type. The by-pass valves are opened by three arms pivoted at one end on a shaft which the governor raises or lowers. These arms are operated by connecting rods driven by eccentrics on the pump-driving shaft. By a link connection, the governor collar thus increases or lessens the distance between the top of the by-pass valve rods and the arms which open them. Upon the relative distance between the top of each valve rod and its corresponding arm depends the length of time the valves are open and the consequent duration of oil supply for combustion purposes.

After the fuel valve closes, the gases work expansively, and the atmospheric and terminal pressures differ but little. The effect of the compressed air used to inject the fuel is inappreciable. The admission valve is open a constant length of time, but the fuel supply is controlled by the governor as just described, so that only at full loads is it injected into the cylinder during the entire period that the valve is open. It has been stated that the thermal efficiency of the Diesel engine runs as high as 38 per cent.

In general outward appearance the engine resembles the ordinary marine type of steam engine. The connecting-rod is carried directly on a pin inside the piston, as usual in single-acting engines. The reciprocating parts are all enclosed within the engine housing, which is fitted with detachable plates for easy access. Lubrication is automatic, a large oil well in the lower part of the housing doing service as a bath into which the connecting-rod crank end plunges at every revolution. Double flywheels are provided for each engine in addition to the driving pulley.

The engines are started by compressed air from auxiliary reservoirs, which are filled by the engine-driven compressor already mentioned. The attendant opens a starting valve which admits compressed air to drive the piston for two or three revolutions, after which the compression in the cylinder is sufficient to ignite the charge; the starting cam is thrown out of action automatically as soon as the attendant throws in the admission and exhaust valve mechanism. Enough air is always stored in these reservoirs to enable the plant to start with ease.

The economy of operation shown by the Diesel engine is of interest. The machines in the new plant are guaranteed to operate on 0·47 lb. of oil per brake horse-power hour at full load, and on 0·5 lb. oil per brake horse-power hour from friction load to full load. With oil at 4·6 cents per gallon, this means about 1 cent per kilowatt-hour, including wages and supplies, the attendance required being very small.

The Armstrong Light & Power Company has been incorporated at Armstrong, B.C.

A by-law authorizing the city council of Calgary, N.W.T., to build and operate its own electric light plant was defeated by eight votes.

Papers were signed on September 12 by which the Kakabeka Land & Electric Company agrees to sell power to the town of Fort William, Ont., in any quantity at $18 per horse power per annum. The company will begin its work in one hundred days, and it agrees to have developed and to deliver to the town 5,000 horse power within two years. The city retains its franchise of light and water.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Conduit Wiring. On going into the various small power houses dotted throughout the country, and also those engine rooms containing dynamos, one is struck by the poor appearance made by the wiring. This is in the main due to the fact that it has been put in on open knobs, instead of in moulding, or better still in conduit. Many purchasers have the good sense to spend a little extra money to purchase apparatus with a good finish and of pleasing lines, but spoil the whole effect by open wiring, which, while perhaps not cheap, can never equal the appearance of concealed work. Besides this question of looks there are also the items of reliability and safety, which are really more important. Wiring protected by conduit is safe from all ordinary causes of disturbance, and consequently the service is more likely to be uninterrupted. The extra cost on the total plant is practically negligible; why not put in what is absolutely the best?

A New Lamp. As is well known by those who have interested themselves in the subject, the light-giving power of an incandescent lamp decreases with age, and, while the current consumption also falls, the two do not change in proportion. That is, the candle power falls off much faster than the current; in other words, the efficiency decreases as the lamp gets older. The argument is sometimes put forth that if the lamp is lighting the place required, and is taking if anything less current than at first, why disturb it? The answer is obvious after a little thought; if the decreased light which you are obtaining is sufficient for your purposes, why not put in a new lamp of that power, but which will give it you with less current consumption than your old one? The question is considered so important by many central stations that, in addition to purchasing their lamps under the most rigid tests and specifications as to maintenance of life, they regularly visit their various customers and remove those lamps which show less than a certain predetermined minimum of light. Recognizing the growing demand for this system of lamp renewal, the Bryan-Marsh Company, of New York, are now placing on the market an article which is an entirely new departure ~~in this line,~~ namely, a lamp which will automatically extinguish itself after its candle power has fallen to a certain fixed point. As at present constructed the apparatus is arranged to go out when its candle power has fallen to about eighty per cent. of the original, which takes place under ordinarily good voltage regulation in about 800 hours. The device is a decided novelty, and its progress will be viewed with great interest by all those who have to do with the manufacturing or operating of incandescent lamps.

Enclosed Fuses. The question of the cost of electrical installations is one which naturally and rightly is given prominence when deciding upon the style and quality of the material to be installed. On the other hand, it is far from good policy to cut the cost of this down to the lowest practicable limit by putting in the cheapest possible material. Such a course is almost certain to mean that the labor will be of a corresponding grade, and that the two between them will make a completed installation presenting chances of dangerous shocks and fire risks which a but slightly greater investment would have totally eliminated. Particularly is this the case with fuses, which so often are still put in of the old open type, without cabinets or other enclosing device, many times without even a porcelain or mica cover. That immediately below them are piles and piles of the most highly inflammable material makes apparently no difference whatever. This construction was excusable perhaps when there was nothing better to be had, but the enclosed fuse is to-day, and has been for some time, ready to supply the demand. True, it has come rapidly to the front, but it is now a standard piece of apparatus, thoroughly reliable in its protective powers, and a great step in advance towards lessening the chances of fires. Surely nobody can afford, for the comparatively slight difference there is in the cost, to put in the open style when the other can be obtained. A few dollars may mean the prevention of a fire, cheap insurance, for no insurance, however heavy, really pays the total loss when you take into consideration the interruption to the service with its consequent loss of revenue and other accompanying worries.

Choice of Frequency.

The choice of frequency in attenating current plants is a most important question, involving as it does in some cases almost the success or failure of the installation, and can only be decided upon after a full consideration of the points pertaining to the equipment and the uses to which it is to be put. Fortunately, there are in this country but a few standard frequencies, and almost all plants use one or the other, though this is far from true as regards European practice, where almost every conceivable periodicity is to be found at one plant or another. The standard high frequencies used here to-day are 133 and 125 cycles, in which event the generators are nearly always small, 200 k.w. or less, and are belt driven or direct connected to high speed water wheels; parallel operation when direct connected to engines is seldom or never attempted. The line reactance is, of couse, very heavy, which means that secondary networks must be small and the length of runs short. Transformers, as a general rule, are smaller and lighter, and therefore more efficient and less costly, the higher the frequency. Induction motors of these periodicities operate usually at higher speeds than those run on the lower frequency circuits, and are mostly single phase. If equipped with condensers the power factor is extremely good. Synchronous motors and rotaries of these frequencies are but seldom encountered, there being great liability to hunting except under the most favorable circumstances. Besides this, the high commutator speeds and the short neutral space, due to the close grouping of the poles, render the latter machine an almost commercial impossibility. Incandescent lamps are, of course, perfectly satisfactory, as is arc lighting, though in the latter case the power factor decreases as the frequency rises, and vice versa, the effect, however, being practically negligible To sum up the question, there is virtually no reason for further installations of these periodicities, unless it be to match apparatus already in place.

The next lower frequencies standard in this country are those of 60 and 66⅔ cycles, 7200 and 8000 alternations, which are classed among the low periodicities. They are those most generally used for lighting where power is also a necessity. Incandescent lamps are, of course, most satisfactory when operated from circuits of this type, as are also arc lamps, the power factor being slightly higher than with 125 or 133 cycles. They are also very suitable for induction motors and fair for those of the synchronous type and for rotaries, though in the latter case the objections of a short neutral and high commutator speeds are still very prominent. The hunting of synchronous motors has also to be carefully guarded against. As was noted when speaking above of transformers, their size and cost increase with a decrease in the frequency, a general rule obtaining for all periodicities. The reactance of wiring is not so pronounced, though still quite large if the heavier sizes are used, which makes it desirable to keep to the smaller gauges, especially if the runs are long. Parallel operation is quite satisfactory when engine driven through belts, or with any style of water wheel drive. When direct connected to engines the latter must govern within fairly close limits to prevent hunting.

Next below 60 cycles comes the frequency of 40, a periodicity used for motor work where some lighting is a necessity, and it is desired to provide for it with the least possible complication and outlay. The line drop is naturally not so great as at the higher alternations, but is still considerable, being 10 to 30 per cent. greater than the actual loss, depending on the size of the conductors used. Induction motors get heavier as the frequency decreases, but on the other hand the power factor is improved, and the possible maximum output, or the breaking down point, is higher. Synchronous motors begin to get more stable, so that the requirements of engines for driving direct are not so severe, either on this point or on the question of parallel operation. The same will apply to rotary converters, which also show better commutation. For lighting this frequency is satisfactory, though flickering begins to make its appearance on the higher voltage incandescent lamps, and also in indoor arc lighting.

The remaining standard frequency is 25 cycles, built in large and heavy units for power work, being always one of the multiphase systems, usually the three phase. Induction motors get heavier, in accordance with the general rule, but the power factors are better. Synchronous motors are most satisfactory, provided, of course, that the conditions are reasonably suited to this type of machine, as are also rotary converters, which can be built with most excellent constants. Incandescent lighting is practically prohibited, except with poor efficiency lamps of low voltage, and arc lighting is almost entirely out of the question. Parallel operation is of course entirely satisfactory, all descriptions of drive and prime movers being coupled in together, the requirements for even direct connected engine work being much less severe.

A new 2,000 light generator will be added to the electric light plant at Guelph, Ont., which has recently been taken over by the corporation.

The power house at Hanlan's Island, Toronto, was totally destroyed by fire on September 25th. The plant was used exclusively for lighting purposes, and together with building, was worth about $50,000.

THE CURTIS STEAM TURBINE.

That steam turbines will before long come into general use would seem to be clearly indicated by the advance that has been made in that direction during the past few years. The strongest point of the steam turbine, no doubt, is its efficiency in operation, it being claimed that it will operate as economically at half load as at full load. In a paper read by Mr. W. R. Emmet at the recent meeting of the American Street Railway Association, the author presents some interesting features concerning the Curtis steam turbine, the right to build which in Canada has been acquired by the Canadian General Electric Company.

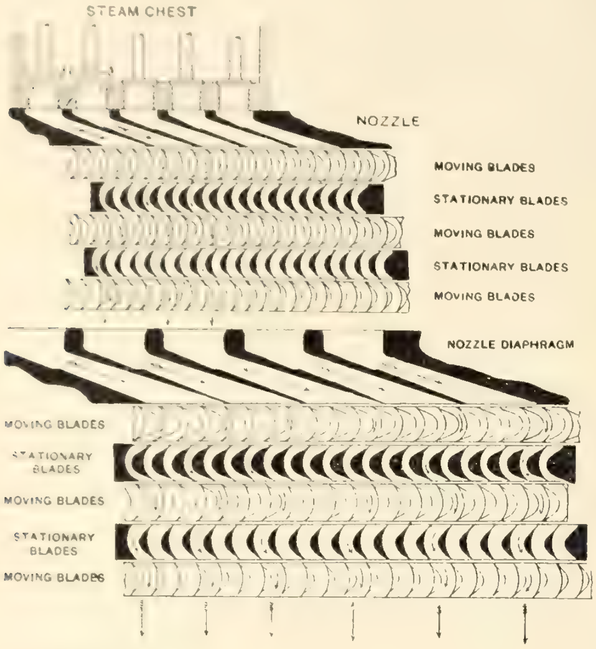


Diagram of Curtis Turbine in Its Latest Form.

The General Electric Company, of Schenectady, N. Y., have erected a large addition to their works to be devoted entirely to turbine manufacture. They have recently installed a 5,000 kilowatt Curtis turbine in the new station of the Commonwealth Electric Company in Chicago. The design of this particular turbine embodies many radical changes as compared with other engines, turbines, or machines of any character. The shaft is vertical; the whole weight of the revolving part is borne by an oil film delivered by a pressure pump to the lower bearing; the delivery of steam to turbine is controlled through a system of electrically operated individual valves worked by a small controller, something after the manner of multiple-unit train-control system; the centrifugal governor moves the controller. The revolving field is mounted upon the same shaft with the turbine wheels, and the stationary portion of the generator is supported by the stationary portion of the turbine, the whole building up into the general form of a vertical cylinder about 25 feet high and about 14 feet in diameter. The total weight of the turbine and generator is about 400,000 pounds, and its capacity is 5,000 kilowatts at full load. It is capable of running at about 75 per cent. overload condensing and at nearly full load non-condensing.

Mr. Emmet says further: The question as to why the vertical-shaft design was adopted for this unit has often been raised and many doubts and criticisms concerning it have been expressed. It is not easy to explain all the reasons which led up to its adoption, but it may be said that the compactness and simplicity of this unit, which are its most marked characteristics, are largely due to the merits of this design. With the vertical-shaft arrangement all lateral strain is removed from the bearings which align the shaft and all deflection of the shaft is avoided with a minimum number and length of bearings. In the vertical design the space between wheels is reduced to a minimum, the supporting structure is perfectly symmetrical and cannot be in any way distorted or put out of line either by mechanical or steam-pressure strains or by the effects of expansion.

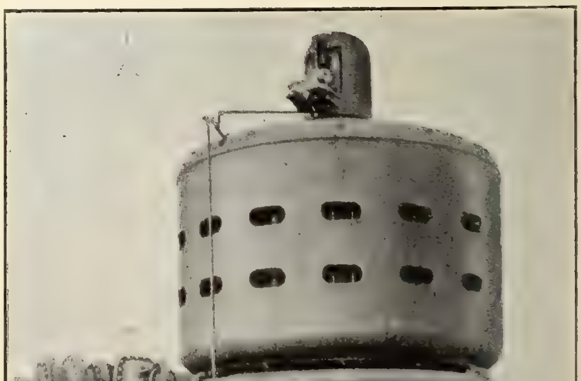
The oil-pressure step bearing at the foot of the shaft supports the whole revolving element in a balanced position by perfectly symmetrical suspension and preserves the exact relation of level between the stationary and revolving parts. As long as this step bearing fills its functions, a multitude of mechanical difficulties and uncertainties are overcome.

At the time this design was adopted there was no good precedent for the support in this manner of such a weight operating at so high a speed, and there were many predictions of failure, examples being quoted where similar methods had failed with waterwheels and other machines. It seemed clear, however, that with proper arrangements the operation of this bearing must be stable and reliable, and since forced lubrication was necessary to success in any case, it seemed advisable to put it where it would accomplish the greatest number of good results.

Experience with a number of machines has fully justified our decisions in this connection. The bearings have run perfectly with an inappreciable amount of friction, and when properly supplied with oil operate with perfect steadiness and regularity. In one respect these bearings have agreeably surprised us, that is, they have been much less injured by stoppages of oil than we expected. In the course of our experiments imperfect pumping arrangements have been used, and repeated failures of the oil flow have been experienced, but in no case has any damage to the machine resulted. Even the cast-iron blocks which constitute the step bearing are, as a rule, not destroyed. Our experience has been that they cut and heat when the oil supply is removed, but in all cases the surfaces have ground themselves to an operating condition after the oil flow is renewed so that the machine could be continued in operation. This might not always be the case, but it seems quite certain that the damage could never be as serious as that which would result from a failure of the lubrication system where heavy weights are carried on high-speed horizontal bearings.

In our newer machines we are providing a heavy stationary collar below the lowest wheel which can be used to support the wheels in case the step bearing is removed and which would serve as a break to bring the machine to rest in case the step bearing should cut enough to allow the wheels to settle to a dangerous degree. Our experience has been that there is very little tendency to settlement of the shaft in case of such cutting, and this latter function of the collar will presumably seldom be called into requisition.

The oil for step bearings and also for the upper bearings of machines is delivered by a small electrically driven pump, which operates continuously from the exciter circuit. In most of the large plants where we are installing turbines we have recommended in addition to these electrical pumps, a weighted accumulator, with steam pump arranged to keep it full automatically. This accumulator with its steam pump affords an automatic reserve for the lubricating system. Its capacity is such that there would be ample time to shut down the units, even if every-



5,000 K.W. Curtis Turbine Direct-Connected to Generator.

thing in the station should be stopped by the bursting of a boiler or steam pipe.

One important matter in connection with the intorduction of our turbines has been the establishment of proper condensing facilities in order that the great benefits of high vacuum might be realized to the greatest possible extent. In turbines which we have tested the steam consumption has been reduced from six to seven per cent. for every additional inch of vacuum above 25 inches. Such a reduction is, of course, very important and justifies large expenditures upon condensing apparatus. The fact that the turbine may be better than a condensing engine with equal vacuum must not be considered a reason for assuming that a condenser which is good enough for the engine is also good enough for the turbine. The selection of condensing facilities should be governed by the economic possibilities.

We have recently designed for some of our large new turbines surface condensers which themselves constitute the base and supporting structure of the machine. These condensers are of very ample cooling surface and so arranged that the maximum degree of vacuum is obtainable with a given amount of water. One feature of our turbine which is very advantageous in obtaining a high vacuum is that it can be easily so arranged that the air leakage is reduced to zero. The two points where the shaft passes through the casing are fitted with packings which are kept sealed by steam. Another advantage is that there is no oil in the steam, and consequently that the exterior of condenser tubes is kept perfectly clean. Several turbines with condenser bases are now being built, and it is probable that there will be a large production of machines of this type.

I have mentioned above that no oil comes in contract with the steam in these turbines, and I need hardly call attention to the great importance of this fact. The condensed water can be delivered directly back to the boilers, and all possibility of trouble in boilers from oil, dirt or scale is eliminated. Even in plants where feed water is good and cheap, this constitutes a great advantage, since a considerable amount of heat is saved by using the condensed steam on account of its higher temperature. There is, however, no such a thing as perfectly pure and clean natural water, and there are few boilers that in their average working condition are perfectly clean. Cleanliness in boilers improves circulation and evaporation, prolongs life and constitutes, therefore, a very distinct and definite advantage.

THE AMERICAN STREET RAILWAY ASSOCIATION.

The twenty-second annual convention of the American Street Railway Association opened at Saratoga Springs, N. Y., on September 2nd. In the absence of the president, Mr. W. Caryl Ely, the vice-president occupied the chair, and delivered an address full of timely suggestions. He stated that according to the last United States census report, there were on June 30, 1902, in the United States 987 companies, owning and operating 22,589 miles of single track, upon which were transported in that year more than four and one-half billion passengers, by the use of more than one and one-quarter million of horse-power. The aggregate mileage run by the cars used in these operations exceeded one billion miles. Referring to the possibilities of interurban electric railroads, he stated that there are now nearly 100 companies throughout the country engaged in the handling of freight and express business, and there are possibly many more which contemplate engaging in this work. There had been an improvement in station equipment and distributing systems, as well as in the character of the rolling stock. In this connection he pointed out that the Union Traction Company, of Philadelphia, contemplated an installation of ten 5,000 kilowatts in steam turbines. Alluding to the possible development of a single-phase motor for interurban railway service, he stated that up to the present time no reliable information had been available, and the electric railway engineers were still dependent upon the direct-current motor for interurban as well as city work.

In a paper on "Steam Turbines," Mr. W. L. R. Emmett presented valuable data regarding the development of that type of steam generator. The paper was followed by an interesting discussion, in which Mr. John I. Beggs, of Milwaukee, referred to the gas engine as a new power which may as far surpass the steam turbine as the steam turbine surpasses the reciprocating engine at least so far as the matter of economy goes. If the predictions made for the gas engine, in using gas now produced as by-products, or in using the ordinary illuminating gas, or producer gas from plants installed in connection with steam plants, were carried out, it would be possible to cut the cost of a kilowatt of current no matter how high the economy of the plant may be—it could be cut in half and possibly reduced two-thirds in cost. He regarded this as an important question. A large engine building concern of the United States had recently acquired the right to build the Nurenburg gas engine and proposed to have one of these engines installed in St. Louis twelve months hence. Where the cost of coal is such a factor that consumers are paying $3.50 per ton for screenings, where four years ago it could be obtained for $1.70, it was easy to appreciate any device which would bring down the cost of producing steam.

The chairman alluded to the fact that in the new plant of the Lackawanna Steel Company at Buffalo, by apparatus quite simple in its nature, the escaping gases from stacks of the blast furnaces and the ovens are recovered, washed and conducted to the engine room, where they are used as fuel, costing nothing to the plant, yet supplying fuel for an installation of 40,000 horse power of gas engines.

Other interesting papers submitted during the convention were: "Electrical Welded Joints," by William Pestell, superintendent of motive power and machinery of the Worcester Street Railway Company; "The Maintenance and Distribution of Alternating Current for Large Cities," by Richard McCulloch; "The Evils of Maintenance and Champerty in Personal Injury Cases," by Michael Brennan, Counsel of the Detroit United Railway; "Train Orders and Train Signals on Interurban Roads," by C. A. Coons, superintendent of transportation International Railway Company, Buffalo; "Freight and Express on Electric Railways," by J. B. McCleary, manager of the railway department of the Birmingham Railway Light & Power Company, Birmingham, Ala.; "The Right of Way," by H. H. Vreeland, president of the Interurban Street Railway Company of New York; and "Comparative Merits of Single and Double-Truck Cars for City Service," by John I. Beggs, Milwaukee Electric Railway & Light Company, Milwaukee.

The question of changing the name of the Association to the American Electric Railway Association was referred to the Executive Committee, who will also decide the matter of the next meeting place. The secretary reported the membership to include 206 companies.

The Canadian delegates to the convention were as follows: C. K. Green, W. T. Marlatt, Hamilton Electric Light & Cataract Power Company; P. J. Myles, Westinghouse Traction Brake Co., Hamilton; E. McKenzie, Toronto Railway Company; B. B. Jenkins, Revolving Sander Company, Toronto; F. E. McCollum, Momentum Brake Company, Toronto; G. Stevenson, Revolving Sander Company, Toronto; J. A. Currie, C. E. A. Carr, E. B. Carrington, London Street Railway Company; T. W. Casey, H. H. Lockwood, W. G. Ross, Montreal Street Railway Company; H. D. Bayne, Montreal, Que.; G. U. G. Holman, H. H. Morse, Levis County Railway Company, Quebec, Que.; W. Phillips, R. R. Knox, Winnipeg Electric Railway Company.

NEW WESTINGHOUSE OFFICES.

The New York offices of the sales organization of the Westinghouse Electric & Manufacturing Company, consisting of the New York Sales Department, Department "I", the Export Department, and the General Agent's Office, have been removed to the new Hanover Bank Building, corner of Nassau and Pine Streets. The new offices occupy the entire seventeenth floor of this building, one of the finest and best equipped office buildings in the country, where the arrangements and facilities will be of the best, both for the representatives of the company, and the public with whom they do business. The mail address of the several departments of the sales organization in New York will be No. 11 Pine Street.

The Executive, Financial and Stock Transfer offices will remain on the fouth floor of the Equitable building.

The present organization of the Westinghouse Electric & Manufacturing Company has been quartered in the Equitable Building since 1889, but the rapid and material increase of business has made the above move necessary.

A. L. and G. H. Voucher, electricians, have started business in Winnipeg.

The Board of Commissioners of Fort William, Ont., will ask for an additional $15,000 with which to complete the improvements to the power plant controlled by the corporation.

QUESTIONS AND ANSWERS

"Enquirer": Would you be kind enough to give me a short rule for remembering the different sizes, etc., of wires, supposing one had not got a table handy?

Ans.—We are not sure that we exactly understand your question, but the following is probably what you want. Namely: Starting with No. 10 wire, it is easy to remember that the diameter is 100 mills (it happens to be the square of 10,) and that therefore the circular millage is 100 x 100 = 10,000 C. M. Further, it has a resistance of 1 ohm per 1,000 feet. The weight is the only odd quantity to memorize, being $31\frac{1}{3}$ lbs. per thousand feet, bare. For the other sizes it is easy to remember that the diameter is halved every sixth size smaller, and as the circular millage is the square of the diameter, the former is halved for every three sizes decrease. Further, the table being arranged as a geometrical progression with a ratio of 1.26, the circular millage of any given wire, multiplied by 1.26, will give the circular mills of the next larger size. It should be noted that the above is true only of the B. & S. gauge table, and that the data given on No. 10 wire is not absolutely correct, though sufficiently so for all practical purposes. Weatherproof wire will average 25 to 35 per cent. heavier than bare, depending on the size and the maker.

"Manufacturer": We have a compound wound direct current 500 volt motor running a rock crusher, and it frequently stops and tries to run the other way, when it blows the fuses and shuts everything down. What is the trouble and how can we remedy it?

Ans.—The difficulty is due in all probability to your having the series coils connected so as to oppose the shunt winding, and when the load gets heavy they are strong enough to overcome the shunt and thus reverse the polarity of the field, which makes the armature run the other way. The remedy is to reverse the series field connections.

"R.F.," Montreal: I have a fan which is to deliver 8800 cubic feet of air per minute, at 3 ozs. pressure. Will you please advise me the size of motor required to drive it, showing how you calculate it?

Ans.—The horse power output from any fan is

$$\frac{\text{Vol. of air in cub. ft. per min.} \times \text{lbs. pressure} \times 144}{33000}$$

In your case this is $\frac{8800 \times 3/16 \times 144}{33000} = 7.2$ horse power.

Assuming that the fan has an efficiency of 80 per cent. the horse power input into the fan, or the power required to drive it, would be $\frac{72 \times 100}{80} = 9$ horse power.

"Engineer": What is an automatic engine? I always understood it to be one which had a governor on it, so as to automatically keep the speed right.

Ans.—The explanation which you give, namely, that any engine equipped with a governor, to keep the speed at the required point, is not correct, though it is popularly held to be so. An automatic engine is one equipped with that style of governor which automatically changes the point of cut off of the steam valve, so as to adjust the supply of steam to the work to be done. Engines which are provided with throttling governors, usually controlled by a pair of fly balls, and which thus wire draw the steam, instead of cutting it off completely, are not automatic engines.

"Ned": In alternating current work what is a reaction machine, a commutator motor and a repulsion motor?

Ans.—A reaction machine is one which excites itself by the reaction of the currents in the armature upon the field; it may be either a synchronous motor or a generator. Alternating commutator motors are those types which contain a commutator, as opposed to those, such as the synchronous and induction, which do not. The repulsion motor is one of the commutator motors, and gets its name from the principle employed to produce rotation, namely, the repulsion existing between the field and armature currents, the former being energized from the primary circuit, the latter being carried through brushes bearing on the commutator and arranged to short circuit the proper coils at the desired instant.

"J. M.": I have been told that in employing a synchronous motor to raise the power factor of a system, that it is possible to put such a machine in and do work with it, the total current taken by the plant being less when the machine is running than without it. Is this possible, and if so what is the explanation?

Ans.—The action of which you speak, which is apparently impossible, often takes place when to a circuit of underloaded induction motors there is added an overexcited synchronous motor. The power factor in the first case is poor, due to the presence of large lagging currents; it is also low in the case of the overexcited synchronous motor, but the current is leading. The result is that the two combine to form a third current, the new load on the system, which has a power factor differing from both its components, and which may in certain cases be less in amount than either of its components. The converse of this proposition is equally curious, namely, that you can shut down the synchronous motor, when the current consumption of the system will immediately rise.

"Electrical Contractor": What is the usual rule for installing arc lamps, that is, how do you calculate how many it takes to light a certain sized building? What is the best kind of globe to use, clear or frosted?

Ans.—The kind of building will affect the question very materially, but for ordinary manufacturing purposes a 450 watt lamp will cover 200 to 250 square yards. For offices and stores this may be somewhat decreased. On the other hand, for outdoor work the area is very much greater, being figured at about 2000 square yards per lamp. For this latter class of work it is usual to put on a clear outer and an opal inner globe, the latter being used to eliminate shadows and sharp rays from the arc. For indoor work both globes are frequently made frosted, though in that case you loose a good deal of the light, as each will cut off 40 per cent. of the light passing through it, whereas the clear globe stops only about 10 per cent.

THE INTERNATIONAL TRANSIT COMPANY AND TRANS-ST. MARY'S TRACTION COMPANY.*

By G. W. Chance.

The lines of these companies are situated in Sault Ste. Marie, Mich., and Sault Ste. Marie, Ont. Each place has a population of about 15,000 and is the center of a large water power development comprising a present development of 40,000 h. p. on the American side and 20,000 h. p. on the Canadian side, controlled by the Consolidated Lake Superior Company, which also controls the lines of the railway and ferry herein described.

The industries of the two sides comprise those largely connected with the Water Power Companies, but in addition on the American side are large lumber mills and tanneries. On the Canadian side there is a large steel plant, two blast furnaces, a rail mill with a capacity of 600 tons a day, a ground wood pulp mill with a capacity of 100 tons a day, a sulphite pulp mill with a capacity of 50 tons a day, also a reduction works, alkali works, a large saw mill with a capacity of 100,000 feet a day, and a veneer mill. On the Canadian side these industries are all located in the western part of the town.

St. Mary's Falls separates the two towns and is immediately below the International Bridge, which is the connecting line between the Canadian Pacific Railway and the Duluth, South Shore & Atlantic Railway and the Soo Line. Both of the latter railways are on the American side.

The length of track at present laid on the American side comprises about 8 miles, including sidings; an extension of 1¼ miles is contemplated to the village of Algonquin, a short distance west of the main town. This place has a population of about 800.

The present eastern terminus of the railway is at the ship-yard known as "Pullar's", where a large paper mill is contemplated and has been started. At this end of the town is located the County Club, Base Ball Parkf and the proposed race-track. The line on the American side runs mainly east and west following the lines of the river, with a belt line around the back part of the town into the residential district running out Ashmun street, which is the principal business street.

The car barns are located on Easterday avenue, on the belt line, and on the south side of the power canal, which runs through the center of the city.

The lines on the Canadian side have for their western terminus the village of Tagona, at which point is located the steel works, and at the east end terminate at the boat club, which is in the residential district.

The car barns on the Canadian side are located at the western end of the line in the village of Tagona.

FERRY.

On the American side the railway runs down to the river and has terminals on the dock immediately west of the power house of The Michigan Lake Superior Power Company, and from thence to Canada the connection is made by a ferry boat with a 20 minute service. This ferry is owned by the Street Railway Company.

The landing in Canada is at the foot of Brock street, which is in the center of the business district.

The route which the railway follows on both sides of the river is very interesting for strangers and tourists, and on the American side runs directly past the great locks of the U. S. Government, through which passes the greatest tonnage in the world. The length of lines on the Canadian side comprises 4 miles.

CHARACTER OF CONSTRUCTION.

The track is all laid of A. S. C. E. 80 lb. T rails, with Bonzano joints, four bolts to the joint. The turn-outs all have automatic spring switches, avoiding all necessity of turning switches, inasmuch as the traffic follows the switches throughout.

The ties are spaced 2 feet on centers and are cedar 6 in. x 8 in. x 8 ft. long and all curves have tie plates or braces. The track generally is located in macadam streets, and in all cases has at least 6 inches of crushed stone ballast under the ties except were the track is laid on the side of a street in the outskirts, where it is laid on gravel ballast.

The special work on the American side was furnished by The Falk Company, of Milwaukee, Wis., and on the Canadian side by the Pennsylvania Steel Company for the car barns, whereas the other special work was manufactured by the company itself at the shops of the Algoma Iron Works.

OVERHEAD WORK.

The overhead work is constructed in a most substantial manner. The poles are all of native Michigan cedar, very straight, not less than 7½ inches at the top and all painted a dark bronze green with white tops, which present a very neat and attractive appearance.

The cross span wire is ⅜ inch galvanized and the pull off wire ¼ inch. All the overhead fixtures are those of the Ohio Brass Company; on the Canadian side "Detroit ears" are used and on the American side a heavy "clinch ear" is used. All the trolley wire is Fig. 8. The feeder wire used is 300,000 C. M. weather proof copper wire. On the American side there are two miles of feeder and on the Canadian side the same.

BONDING.

The bonds used are those of the Mayer & Englund Company, of Philadelphia, and are known as the "foot bond", the terminals being placed in the base of the rail and the bond being of a horseshoe shape; the capacity of these bonds is 0000.

The contractors for the construction work on the American side were The Falk Company, of Milwaukee; on the Canadian side the contractor was J. H. McKnight, of Toronto.

CAR BARNS.

The car barns on each side of the river are practically the same in construction and size. The main building is 65 feet x 153 feet, with a large wing for offices.

The repair shop is located in the barn proper.

There are four inspection pits in the barn.

The side walls are brick; the front stone, and the building has steel roof trusses with corrugated steel roofing; the interior of the building is finished in white, while the outside of the roofing is painted dark green —graphite paint.

There is 3 inch pine flooring all over the building inside the car barn proper and the machine shop is separated by corrugated steel from the storage part proper.

EQUIPMENT.

On the American side the equipment consists of 6 semi-convertible cars designed by the manager of the road and built by the St. Louis Car Company. The cars are 32 feet over all and will seat 32 to 36 people.

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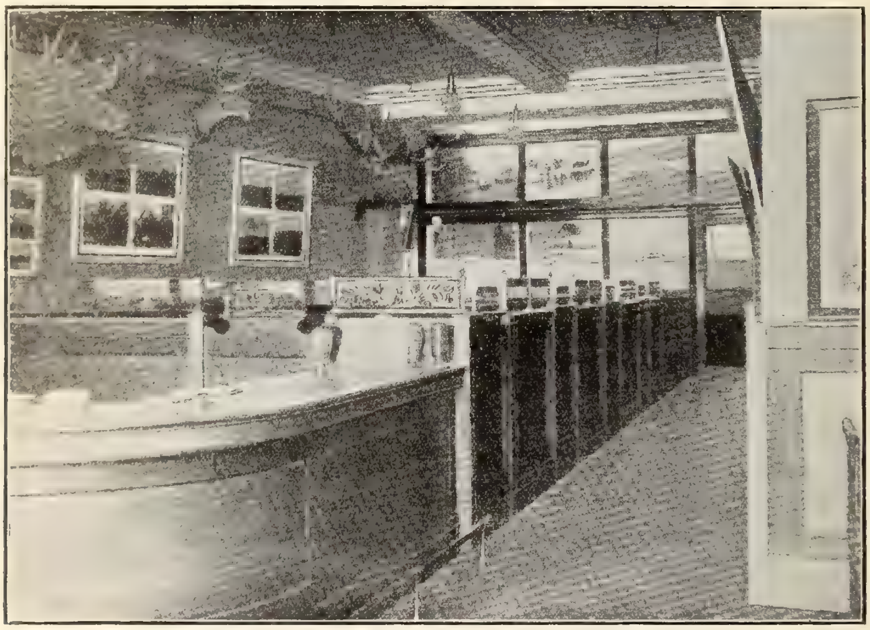
*Since this article was written the Consolidated Lake Superior Company have encountered financial embarrassment but no doubt arrangements will be made to continue the operation of the electric railway as well as the many other important industries controlled by the company.

There are four cross-seats on each side in the center of the car and in each end longitudal seats. The cars are equipped with electric bells and have Ohmer fare registers, and are all equipped with equipments of Providence fenders, type "C". The inside finishing of the car is in oak and the outside is painted vermillion for the body color and the upper part a citron shade.

The electrical equipment consists of two No. 49 Westinghouse motors to each car, with two K10 controllers and circuit-breakers. The trucks are of the Dupont pattern; the wheels have 3 inch treads, ⅞ inch x 1⅛ inch flanges.

On the Canadian side the cars were built by the Ottawa Car Company, from designs by G. W. Chance, manager of the road. They are eight in number, 42 feet over all, and are of the semi-convertible type.

The trucks are Brill No. 27 G, equipped with four C. G. E. No. 67 motors, and the cars have two K6 controllers to each car, together with circuit breakers.



New Canadian Emigration Offices, London, England.

The cars have five cross seats on each side, made by Hale & Kilburn, of the Walkover pattern, covered with Pantasote, and on each end the seats are longitudal covered with rattan. The cars are equipped with the Momentum brake, manufactured by the Momentum Brake Company, of Toronto. These brakes are very effective and consist in two disks with wooden rubbing services and cast iron construction in general; a sheave and winding chain throws the brake on.

The cars on the American side are equipped with Sterling safety brakes with bevel gear attachment at top of brake staff.

The cars on the Canadian side are painted similar to those on the American side, vermillion body, citron upper part. There is a travelling trolley used on the cars on the Canadian side.

It is intended to add three large cars of the same pattern as those on the Canadian side for the American side, equipped with four Westinghouse No. 49 motors and K6 controllers.

FERRY DOCKS AND BOATS.

The company owns two docks, one on each side of the river, and on each are commodious buildings for ferry purposes. They also own two boats each with a carrying capacity of about 1000 people. One boat at present is used for the regular ferry service and the other one is an extra and excursion boat.

POWER.

On the American side the company takes power from The Michigan Lake Superior Power Company. The machines for this purpose are Stanley generators generating current at 600 volts. The water wheels are regulated by Lombard governors.

On the Canadian side the company takes power from The Lake Superior Power Company. The generators used were manufactured by the Canadian General Electric Company and furnish current at 550 volts. The water wheels are here likewise governed by Lombard governors.

NEW CANADIAN EMIGRATION OFFICES.

The remarkable growth of emigration from Great Britain to Canada has necessitated the erection by the Dominion Government of large new offices in London, England. These new offices, which were opened in April, are located at Charing Cross, in the centre of the Metropolis. They comprise a very imposing block of buildings of commanding appearance, and should provide adequate accommodation for the purpose for which they have been erected for many years to come.

The accompanying illustration shows a portion of the interior of the ground floor. It is partitioned off for various departments. The office of Mr. T. R. Preston, the Canadian Commissioner of Emigration, is on the ground floor. All the fittings are of Canadian wood, comprising bird's-eye maple, cherry, ash, and oak, the fittings having been mainly supplied by the Office Specialty Company, of Toronto, and the Canadian Office and School Furniture Company, of Preston. All the offices are admirably arranged to meet the work of this department, which now comprises quite a considerable staff.

The University of New Brunswick have decided to increase the tuition fees for engineering students from thirty to fifty dollars per year, but the proposed change will not be made until the beginning of the next academic year.

MONTREAL

Branch office of the CANADIAN ELECTRICL NEWS,
Imperial Building.

October 6th, 1903.

Contracting business, which has been pretty dull in Montreal since the latter part of June, is again picking up.

Amongst trade visitors lately in Montreal were Mr. Johnston, representing the American Marble & Toy Company, of Akron, Ohio, and Mr. C. B. Fewings, representing the McDonald & Wilson Company, of Toronto.

Montrealers in their private capacity will begin to find soon that it does not pay to have their Aldermanic representatives too attentive to civic arc lighting franchises and lose sight of incandescent for private consumption. It would seem that the Montreal Light, Heat & Power Company will shortly reimbure the low cost of arcs from incandescent and power. The discount on incandescent, formerly 33⅓ to 40 per cent., will shortly be reduced to 5 per cent. or 15 per cent. for a five-year contract. In some cases motor power has already been advanced from $60 per horse power per annum to $100.

Wild schemes are floating in the air as to new companies being formed. One is to utilize the water power at the dam at Carrillon on the Ottawa river; another to bring it from Massena, &c. Mr. W. MnLea Walbank, formerly manager of the Lachine Rapids Hydraulic Company (absorbed by M.L.H. & P. Co.), was coupled to various schemes, but this gentleman publicly denies any connection with such, which can therefore be taken as existing more in a desire than an actuality, or surely Mr. Walbank's statement would have mentioned whether he had been approached or no.

Mr. Phelps, of Baltimore, has been engaged by the city to report on a conduit scheme so as to get rid of some of our forest of unsightly poles. This expert proposes a common conduit of brick, to be built and leased "per duct per mile" by the city, the charge for rental being based on "interest on the expenditure." Some local electricians doubt the feasability of a common conduit of this nature on account of our severe climatic conditions. They also seem to think the cost to construct will be high, owing to the quantity of rock substrata which exists. There can be no two opinions, however, on one point, and that is that if built by the city the cost is almost sure to exceed any figure at which it could be done by either the existing companies or a specially formed conduit company for the purpose. However, several speeches miles long will have to be delivered as yet before anything practical is arrived at by our worthy city representatives.

The Bank of Ottawa's new building is in the hands of Mr. H. C. Stone, architect. Tenders are now being called for the electric wiring of same in iron conduit.

It is said that the Eugene F. Phillips Electrical Works are looking for a new factory site, having outgrown their present building and being unable to extend any more in their present locality. It has been a matter of night and day work with them for some time to try and keep pace with the orders in hand for weatherproof and other wires which they manufacture.

The usual fall busy season came to hand about September 1st as usual, and there are few complaints relative to lack of orders. The contractors complain of a lack of really competent wiremen, the reason probably being that there is more remuneration for them on the other side of the line.

Messrs. T. Pringle & Son, mill engineers, are superintending the construction of two large additional buildings for the Dominion Oil Cloth Company of this city. They are asking for tenders for electric light wiring for the buildings.

As a visitor remarked—"one cannot hear himself think for the noise of your cars." Certainly Montreal takes the medal for "roarers." The Montreal Street Railway might take a leaf from the book of Quebec, Toronto and Ottawa, and try to improve matters along this line. Why the Bell Telephone Company have not taken action before this for affecting their service is a wonder, as many a telephone subscriber requires to stop his conversation until the "noisy car" goes past.

A Boston manufacturer was surprised that we could buy so many electrical fittings to better advantage in Canada. There's a heap more surprises coming to him soon on this count.

Mr. Ernest Craig, who is leaving the Standard and Citizen Companies for Niagara Falls, is one of our pioneers, and kept circuits going in the old times when machines did not prove as tractable as they do now. Quite a few remember Craig's "Bernstein" incandescent circuits which lit the suburbs of Westmount and St. Cunegonde. The Craig station was located in the latter place, where Mr. Craigs senior, and Mr. Ernest Craig waged incessant warfare with the then Royal Electric Company for the lighting franchises of suburbs, and with a fair measure of success. Finally, the Royal Company bought out Messrs. Craig's station, and Mr. Ernest Craig then shortly afterwards did good work for the Citizens' Light and Power Company with the steam station at Cote St. Paul. The Citizens' Company affiliated with the Standard Company, both came under the regime of the Lachine Company, and now finally all are merged with the Montreal, Light Heat & Power Company. It would be difficult to find an enemy of Mr. Craig and his many friends will be sorry to lose him from Montreal. He was thoroughly practical, and unlike some others, was not averse to imparting his knowledge to those less favored who sought his advice.

WATER POWER DEVELOPMENT FOR SHERBROOKE, QUE.

Messrs. Ross & Holgate, hydraulic and electrical engineers, of Montreal, were commissioned by the City Council of Sherbrooke, to Que., report upon the development of the Westbury Basin water power, situated about eighteen miles from the city limits. The report states that the minimum flow of the river is 40,000 cubic feet per minute and the head available 37 feet, the equivalent horse power being 2,800. They recommend the dividing of the power plant into three units, providing room for a fourth unit to be installed only when the minimum flow has increased. Each power unit is to consist of a three-phase 60-cycle 500 k.w. generator running at about 425 revolutions per minute and driven by two pair of turbines on horizontal shaft coupled direct to the shaft of the generator; separate duplicate exciters independently driven to be provided. The generators are to operate at a voltage of 2,000, which is to be stepped up to 20,000 volts and transmitted to the Sherbrooke sub-station, when the voltage will be stepped down for distribution of current throughout the city.

For a development of 2,500 horse power the cost is placed at $207,226, made up of $19,000 for hydraulic machinery, $42,800 for power station electrical equipment, $18,000 for sub-station, $87,550 for dams and work apart from machinery and lines, and balance for contingencies, engineering and superintendence. A second estimate is $188,526 and covers power house and other works for four units, only three of which to be installed at present. The power developed in this case would be 1,875 horse power. Estimate No. 3 covers power house and other works for three units, only two of which to be installed at present. The cost for a development of 1,250 horse power is placed at $150,973.

The relative cost per horse power delivered in Sherbrooke would be as follows: For 2,500 h.p., $82.89 per h.p.; for 1,875 h.p., $100.60 per h.p.; for 1,250 h.p., $120.80 per h.p. These figures, it is stated, do not give an estimate of the amount of power available for sale, as, due to the overlapping of the power demand for a plant of this kind, it is estimated that the horse power to be sold can safely be increased 50 per cent. above these figures, so that the commercial horse power available for sale in each case would be as follows: No. 1, 3,750 horse power, capital cost per h.p. $55.26; No. 2, 2,812 horse power, cost $67.07; No. 3, 1,875 horse power, cost $80.54.

ENGINEERING and MECHANICS

THE C. A. S. E. SECRETARY.

Mr. Walter Ingles, who was re-elected Secretary of the C. A. S. E. at the Berlin convention in August last, is a member of Toronto Branch No. 18, which he joined in 1892. He was financial secretary for two years and afterwards president of that branch. For some years he has been chief engineer for the Canadian Oiled Clothing Company, and resides at 554 Bloor street west. He is a well known Forester, having filled offices in both the Ancient Order and the Canadian Order. In re-electing him to the position of Executive Secretary, the members attested their belief that the duties pertaining to that office are well performed.

MR. WALTER INGLES.

FIELD COIL TEMPERATURES.

In a paper recently read before the American Institute of Electrical Engineers, M. Clarence Renshaw gives some figures showing the actual temperature reached in the field coils of an electric tramcar during its daily working. The temperatures in question were measured by noting the resistance of a coil of carefully calibrated wire embedded in the field coils whilst the latter were being wound. The observations made extended over two days, during which time the car made its ordinary service runs. At starting, on the first day the coils were found to have a temperature of 25½ deg. Cent., or 13 deg. Cent. above the surrounding air. This temperature gradually rose, and at the end of eight hours was 74 deg. Cent., at which figure it remained constant for the next eight hours, the maximum temperature rise being thus 64½ deg. Cent. During the following three hours, which were late in the evening, the air temperature fell, and with it the temperature of the coils, which was 70 deg. Cent. at the end of the day's run. This temperature fell during the night; but on taking out the car for its next day's work, four hours later, this temperature was still 32 deg. Cent., or 20 deg. Cent. above the surrounding air, so it would seem that the field coils of these cars never get quite "cold" in actual service. When drawing a "trailer," the temperature rise was much more rapid than when the car ran alone, and in an evening run under these conditions a temperature of 98½ deg. Cent. was noted at the end of 1½ hours' run. With the removal of the trailer the temperature gradually fell, reaching 74 deg. Cent. at the end of three hours. The car used in the experiments was of the single-truck type, with seats for 28 passengers. It weighed 12 tons empty, and was fitted with two Westinghouse motors, designed to give a mean speed of 26 miles per hour on the level. The actual average speed, including stops, was 10.7 miles per hour. The average number of stops made was between four and five per mile, the average duration of which was four seconds, and the maximum 15 seconds. The passengers carried numbered 956 in a day of 18¼ hours, and the average load was 24.

ENGINEERS' BANQUET.

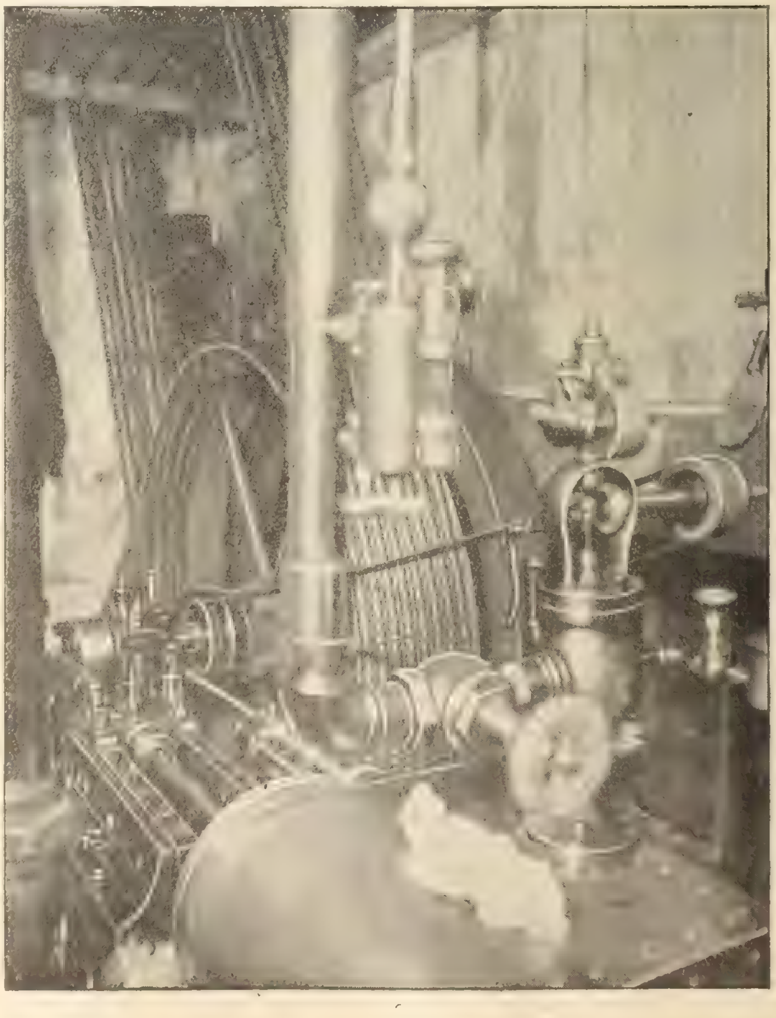
Arrangements have been completed for the annual dinner of Toronto N. I. C. A. S. E. to be held at the Walker House on Thanksgiving Eve, October 14. A good entertainment is promised by the committee, the personnel of which is as follows: G. C. Mooring, chairman; W. H. Johnston, secretary; J. G. Bain, H. E. Terry, J. Bannon, Alex. Storer, W. Oathwaithe and A. J. Butcher.

A 100 H. P. MAIN DRIVE.

As power users become more and more familiar with the advantages, economy and adaptability of the rope drive, as exemplified by the Dodge Continuous System, manufactured by the Dodge Manufacturing Company, of Toronto, Limited, installations of this drive become more and more numerous.

In the accompanying illustration we show a main drive of 100 horse power from the engine at the factory of F. Schryburt & Company, of Quebec, which is one of the drives recently installed by the Dodge Company, and which makes an exceedingly efficient drive.

The Dodge continuous rope drive is recognized for its efficiency and economy. It is both economical in first cost and in operation, runs noiselessly and satisfactorily and is wonderfully elastic--by its use many drives over obstacles and at difficult angles, which otherwise might be well nigh impossible, are easily accomplished.



MAIN DRIVE FROM ENGINE ROOM AT FACTORY OF F. SCHRYBERT & CO., QUEBEC.

TELEGRAPH and TELEPHONE

RESIGNATION OF MR. H. P. DWIGHT.

On September 30th last Mr. H. P. Dwight retired from the active management of the Great North-Western Telegraph Company, after an unbroken service of fifty-six years. Mr. Dwight will still participate in the direction of the company's affairs, having retained the office of president. He has been succeeded as general manager by Mr. Isaac McMichael, a native Canadian who has been manager of the Minneapolis and North-Western Districts for the Western Union Telegraph Company, with headquarters at Minneapolis.

Mr. Dwight is in his seventy-fifth year, but still enjoys a splendid constitution. The story of his life is one of steady advancement from a telegraph operator to the presidency of the Great North-Western Telegraph Company, with 2,000 offices and 50,000 miles of line. He learned telegraphy in Oswego and soon became one of the best operators in the State of New York. On the 27th September, 1847, he took charge of the Kingston office of the Montreal Telegraph Company, but a few months later was promoted to Montreal, where he remained till 1850, when he came to Toronto. Mr. Dwight's executive ability was soon recognized and he was promoted to the positions of general assistant, general superintendent and superintendent in rapid succession. When the Dominion and Montreal Telegraph Companies were merged, under the charter of the G.N.W., in 1881, Mr. Dwight was appointed general manager of the united companies. Shortly afterwards he was elected vice president, and in 1893 was honored by election to the presidency.

TELEGRAPHIC SERVICE FOR PRINCE EDWARD ISLAND.

At the recent meeting of the Maritime Board of Trade, held at Charlottetown, P. E. I., Mr. F. L. Haszard, K.C., brought up the subject of the unsatisfactory condition of the telegraphic communication between Prince Edward Island and the mainland. He pointed out that part of the terms on which that province entered into the Dominion Confederation were that telegraphic connection with the mainland would be undertaken and maintained. There was now only a very poor service, for which excessive rates are paid. He had been told that the Government were considering the advisability of having a wireless telegraphic service installed.

Mr. George E. Hughes, M.P.P., said that for a part of the year the telegraphic service was actually their mail service, and there was no doubt but that a large amount of business was lost through the lack of the was proper communication. The following resolution adopted: "That in view of the fact that the telegraph service is one which is clearly the duty of the Federal Government to remedy, this Maritime Board of Trade expresses its regret that nothing has yet been done to remedy the grievances complained of, and strongly urge upon the Government its imperative duty to make the service satisfactory; and that the representatives from the Maritime Provinces be requested to press this matter on the consideration of the Government, so that immediate action may be taken, and that the secretary of the board be instructed to send a copy of this resolution to each of the Maritime representatives."

THE STATUS OF WIRELESS TELEGRAPHY.

The protocol adopted by the recent congress at Berlin, Germany, in regard to wireless telegraphy has been signed by the United States, Germany, Austria, Spain, France and Russia, but not by Great Britain or Italy. The principal provisions are that coast stations shall be constructed so as to allow communication with ships at sea regardless of the particular system carried by the vessel and the publication of technical explanations of all systems in order to facilitate the transmission of messages. It is also provided that it shall be the duty of all wireless systems to forward reports of accidents and requests for assistance. A universal system of charges is to be introduced. The services are to be so regulated that signal stations will disturb each other as little as possible.

The delegates from the United States to the Etheric Congress stated that owing to the laws of their country the American Government would not be able to prevent private companies from erecting wireless stations merely because they declined to exchange telegrams with stations belonging to another system. The delegates, however, have a general adherence to the principal promulgated by the majority of their fellow-confreres.

The British representatives dissented from a majority of the conclusions adopted. They affirmed that no system would be used unless a certainty of connections were guaranteed.

The Italian representatives supported the Englishmen, declaring that Italy could not repudiate its agreement with Signor Marconi. They added, however, that they would try to persuade him to modify his views on the subject in accordance with those of the majority of the delegates to the convention. The British delegates agreed to submit the conclusions of the conference to their Government, but expressed doubt as to the willingness of the English postal authorities to concede equal rights of all systems, owing to the legal status of wireless systems in Great Britain.

TELEPHONE NOTES.

The Bell Telephone Company has no less than twenty-seven miles of conduit in the city of Montreal, containing 648,266 feet of duct, besides another 100,000 feet of duct in the branches leading into lanes and other points of distribution. The company has found that while, generally speaking, the original cost of laying a conduit is five times as much as one of poles and wires, the expense of maintenance is only about 15 per cent., owing to the immunity from storms and other sources of damage existing above ground. The principal danger and cause of deterioration in underground stock so far, Mr. L. B. McFarlane says, has been found to be from electrolysis, as a result of so much electric current going back from the trolley car tracks to the power house. The current follows the lead coverings of the telephone cables, and where it leaves the electrolytic action sets in, resulting in the lead covering being eaten off the cable. Only the watchfulness of the company's engineers prevents serious damage in this connection. The most serious objectoin to the use of a common conduit by low potential concerns like telegraph and telephone companies and high potential electric light and power systems, is well known to be the difficulty in maintaining complete isolation between the two, particularly in the manholes.

The city of Hamilton, Ont., have given the Bell Telephone Company an exclusive franchise for five years. The company is to pay $1,450 on the execution of the agreement and $2,900 a year for five years. The company agrees that it will not increase the rate charged the city or the Board of Education, the number of 'phones not to exceed 125. It also agrees to maintain and keep in repair without charge the poles and wires used in connection with the city police patrol system, and permit the city to use the cross arm on every pole for the fire alarm wires. Provision is also made that as soon as the switchboard is in operation all subscribers will be supplied with long-distance instruments free of charge, and that all agreements to pay extra charges for these instruments shall cease on January 1, 1904. The rates are fixed at $30 a year, unlimited calls for private residences; $25 a year and 2 cents a call, measure service plan for private residences; $20 a year, with an allowance of 100 calls each month, and 2 cents a call for all extra calls for dwelling-houses, on a party line not more than four on a line. The charges for offices or for houses used for trade, etc., $45 a year for unlimited calls; on measured service plan, $25 a year and 2 cents a call; offices on party lines, $35 a year with 100 calls a month, and 2 cents a call for all calls over 100 a month.

DISPLAY OF TRANSMISSION APPARATUS.

Among the many remarkable exhibits at the recent Toronto Exposition, that of the Dodge Manufacturing Company, Limited, of Toronto, was worthy of particular note.

The exposition of a complete rope drive from the main shaft in the building, exploiting with remarkable simplicity the Dodge continuous system, presented a clear demonstration of the exceeding efficiency for which it is so famous. Advantage was also taken of this opportunity to present to the public eye the Dodge travelling take-up carriage in its relation to the rope drive.

Exhibit of the Dodge Manufacturing Company at Toronto Exhibition.

The Dodge friction clutch, one of the company's many specialties, was attached to a piece of shafting which served as a railing for the exhibit. It was thus in a place convenient for the inspection of the many interested spectators.

Piled in great columns at one side were another of the company's specialties—the Dodge split wood pulleys. The company was somewhat handicapped in this line of its exhibit, being unable to do itself justice, as only the smaller pulleys could be exhibited, the larger ones ranging as large as 30 feet in diameter.

The booth itself contained a display of the complete line of couplings, hangers, machine moulded iron pulleys, clutches, ring, chain and capilary self-oiling bearings, and a full line of grain and elevator machinery.

The exhibit as a whole did as much credit to the company as could be expected, since to demonstrate the true worth of the Dodge appliances would mean a matter of years, as any article of a mechanical nature can be shown while new in satisfactory operation, the only real test being found in subsequent years in their continued efficiency, freedom from repair, and long levity. And as the thousands of Canadian mannfacturers testify, it is in these respects that the supremacy of the Dodge appliances is maintained.

IMPORTATION OF MACHINERY INTO SOUTH AFRICA.

A consular report says that the importation of machinery into South Africa is increasing, the total for the last fiscal year exceeding $4,000,000 in value, as compared with $3,000,000 for previous year. The steady extension of the railroads in South Africa accounts for the increased importation of locomotives, which were valued in the three years at $545,315, $1,148,095, and $1,963,253, respectively. New lines of railroad, estimated at 4,000 to 5,000 miles in length and to cost about $100,000,000 to $125,000,000, are projected. American manufacturing concerns are already in the field; thus the Westinghouse Company has a contract for the construction of a line of roads in the De-Beers mining district. The General Electric Company, of New York, is to furnish to the railroad shops of the Natal Government 119 motors, 6 dynamos of 300 horsepower each, 3 electrical cranes, and other appliances. Another United States firm has received an order for 7 locomotives for the Cape Colony railroads. The municipal tramway of the city of Durban is being constructed by an American firm.

Whittaker & Company, 2 White Hart Street, Paternoster Square, London, E.C., have issued a valuable work entitled "Whittaker's Electrical Engineers' Pocket Book." The editor is Kenelm Edgcumbe, A.M. Inst. C.E., A.M.I.E.E., and the price is three shillings six pence net. This book differs in many respects from previous publications of a similar kind. It does not merely give a number of formulæ, rules and data, collected from various sources, but contains a kind of synopsis on each subject brought thoroughly up-to-date. The subject of dynamo design has been treated very fully and the section on "Estimating for Electrical Machinery" should be found useful.

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1-50 K.W. S.K.C. Generator, 2000-1000 volts, 8000 alternations, with 2½ K.W. Exciter and Station Apparatus complete.
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1-25 K.W. R. E. Co. B-iPolar D. C. Dynamo, wound for 110 volts, with sliding base, pulley, brushes, etc., complete.
2-12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.
The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address
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PERSONAL.

Mr. Roderick J. Parke, electrical engineer, of Toronto, is at present on a business trip to British Columbia.

Mr. Thomas Ahearn, of Ahean & Soper, Ottawa, who with his wife and family spent the summer in Europe on a pleasure trip, arrived home early in September.

Mr. T. H. Creden, general manager of the Cape Breton Electric Company, has tendered this resignation to accept an important commission in Boston. He will be succeeded by Mr. E. S. Dimmock.

Mr. J. J. Wright, manager of the Toronto Electric Light Company, after spending three months in Muskoka, has returned home in greatly improved condition. His friends hope to see him again "on deck."

Mr. C. F. Beauchemin, who was prominently connected with the formation of the Merchants Telephone Company in Montreal, died at Farnham, Que., on September 26th.

Mr. Ernest Craig, who has been secretary-treasurer and superintendent of the Standard Light & Power Company and the Citizen's Light & Power Company in Montreal for the last ten years, has accepted a responsible position with the Toronto-Niagara Power Company at Niagara Falls.

Prof. William J. Sweetser has been appointed professor of manual training and engineering at Mount Allison University, Sackville, N. B. Prof. Sweetser studied manual training in the Cambridge School, one of the finest in America. He graduated from the Massachusetts Institute of Technology with the degree of B.Sc., having made a specialty of mechanical engineering.

Mr. W. H. Moore, assistant to the president of the Toronto Street Railway and general manager of the suburban lines, was seized with an attack of appendicitis while on a business trip to Ottawa last month. The attack rendered an immediate operation necessary. This was performed in the Protestant General Hospital, since which time Mr. Moore has made rapid strides towards recovery.

Mr. Samual Rogers, president of the Queen City Oil Company, died at his residence, 107 Avenue Road, Toronto, on Sunday, September 26th. Mr. Rogers had been in delicate health for two years, being troubled with an affection of the heart. He was 69 years of age and was born in North York, where Timothy Rogers, great-grandfather of the deceased, settled in 1800. Deceased established the Queen City Oil Company in 1877, his son, Mr. Albert Rogers, now being the acting manager. Mr. Rogers was a man of spendid business qualities and of wide charity. He is survived by a widow, two sons and four daughters.

SPARKS.

Whitby, Ont., is about to install an electric light plant. The work is in charge of Mr. R. E. Speakman, C. E., of Toronto.

The Bell Telephone Company have made a new proposition to the City Council of Ottawa, agreeing to enter into a five-year contract to furnish domestic instruments at $25 per year and to provide 50 instruments for civic use free of charge.

It is reported that Canadian capitalists have secured the Ruthenberg process of making steel by electricity and in the near future will construct a mammoth electrolytic steel plant on the Welland river at Chippewa, utilizing the Niagara power.

The Summerside Electric Company, of Summerside, P. E. I., have just installed a new Leonard Corliss engine of 200 horse power. The fly wheel is 12 feet in diameter, and the engine complete weighs about 30,000 pounds. The plant of this company is now up-to-date in every particular.

An Ontario charter has been granted to the Thornbury Gasoline Engine & Foundry Company, to manufacture gas and gasoline engines and motors, steam engines, electric motors, etc., at Thornbury, Ont. The promoters include Messrs. H. A. Carmichael, of Thornbury, and D. A. McDonald, of Glencoe.

Mr. A. J. Andrews, representing an American syndicate, has submitted a proposition to the city council of Winnipeg to develop the water power of the Assiniboine river. He guarantees to develop immediately 4,000 horse power and to furnish the city with what power is required at $40 per horse power per year for a 24-hour service.

Labor Day beat all previous records for street railway traffic in Montreal. Without counting transfers the company carried 324,419 passengers and the receipts totalled $13,939. The previous highest record was the first Monday in September of last year, when 263,794 passengers were carried and the receipts totalled $11,223.

A resolution introduced to the Dominion Trades Council providing for the licensing of stationary engineers, was referred back by the committee so that a limit of horse power should be fixed. It is proposed to restrict the license to 25 horse power and upwards, so that the regulation will not interfere with the employment of stationary engineers in rural districts and for threshing purposes.

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MONTREAL

SPARKS.

The property of the Coaticook Electric Light & Power Company came under municipal control on October 1st. Mr. Bower, of Morrisburg, has been engaged to take charge.

Messrs. Cadmas & Coe, exporters, New York City, have recently purchased from J. C. Wilson & Co., Glenora, Ont., for a client abroad, the complete outfit for the equipment of a water power their customer is developing. The outfit is to consist of an 8-inch "Little Giant" water wheel, the necessary iron flume, shafting, gearing, couplings, flat and upright bearings, etc.

The Canadian Bullock Electric Manufacturing Company have secured the contract for the electrical equipment of the Sudbury Power Company. It embraces 100 k.w. in 3-phase generators, 60 cycle, two 40 k.w. exciters direct connected to water weeels, six step-up transformers, and three step-down transformers. The chief engineer of this work is Mr. T. T. Simpson, of Deschenes, Que.

The Montreal Star is authority for the statement that Messrs. Brown, McFarlane & Co., a Glasgow (Scotland) firm of turbine engine manufacturers, are making arrangements with the Canadian Pacific Railway Company for the installation of turbines in the latter's lake boats. Mr. McFarlane looks forward to the day when all steamships on the great lakes will be fitted with them.

Attention is called to the advertisement in this number of the Canadian Casualty & Boiler Insurance Company, whose head office is in Toronto. The managing director of this company, Mr. A. G. C. Dinnick, is a gentleman of wonderful ability and great business experience. He has associated with him the best possible men for the positions required in the inspection and insurance of boilers, etc.

An electric car ran at the rate of 108 4-5 miles an hour at Berlin, Germany, on September 17th, which is said to be the highest speed ever attained. The engineers in charge of the experiments expect that 125 miles an hour will be reached. It was found last year, when a speed of 99½ miles was achieved, that the 70-pound rails and ordinary ballasted roadbed would not stand the strain. Since then the roadbed has been reconstructed with broken basalt and closely set with pine ties faced with oak, so as to combine the springiness of the pine and the hardness of the oak. The new rails weigh a little over 100 pounds. Alterations have also been made in the motor. The details of the experiments are kept secret, but a summary of the results will probably be published at the end of the trials.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Nov. 1	1 10	Nov. 1	6 00	4 50
2	2 10	2	6 00	3 50
3	3 10	3	6 00	2 50
4	4 00	4	6 00	2 00
5	No Light	5	No Light	.....
6	"	6	"	......
7	5 15	7	8 40	3 25
8	5 15	8	9 40	4 25
9	5 15	9	10 40	5 25
10	5 15	10	11 45	6 30
11	5 10	12	0 50	7 40
12	5 10	13	2 00	8 50
13	5 10	14	3 00	9 50
14	5 10	15	4 15	11 05
15	5 10	16	5 20	12 10
16	5 00	17	6 15	13 15
17	5 00	18	6 15	13 15
18	5 00	19	6 15	13 15
19	5 00	20	6 15	13 15
20	5 00	21	6 15	13 15
21	5 00	22	6 15	13 15
22	5 00	23	6 15	13 15
23	5 00	24	6 15	13 15
24	5 00	25	6 15	13 15
25	9 00	26	6 15	9 15
26	10 00	27	6 15	8 15
27	11 00	28	6 30	7 30
29	0 00	29	6 30	6 30
30	1 00	30	6 30	5 30
		Total		239 05

CHANDLER CANADIAN PATENT NO. 63721

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TRADE NOTES.

The New York sales offices of the Nernst Lamp Company have recently been removed from the Equitable Building and transferred to the new Hanover Bank Building, No. 11 Pine street.

Messrs. Sadler & Haworth, of Montreal and Toronto, have for many years been engaged in the manufacture of leather belting. In their advertisement in another part of this number, they direct the attention of the readers of this journal to the high standard of merit which their product has attained.

A special tariff edition of the Canadian Manufacturer, just published, contains an accurate reproduction of the official texts of the tariffs of Canada, United States, Great Britain, the Commonwealth of Australia and British South Africa, and will be found valuable for reference.

Numerous orders for "Little Giant" turbines to go abroad are being received. The makers, J. C. Wilson & Co., Glenora, Ont., report the foreign demand far in excess of any previous season. Recent shipments include one 16-inch and six 12-inch wheels to London, England, and they have now under construction a double 44-inch wheel for Liverpool, England.

The following orders have recently been placed with J. C. Wilson & Company, Glenora, Ont. : J. A. Tett & Bro., of Bedford Mills, Ont., a 33-inch "Little Giant" water wheel, together with shafting, gearing, bearings, and other accessories ; Brant Milling Company, Brantford, Ont., a 10-inch "Little Giant" turbine for their flour mill at St. George, making the sixth "Little Giant" installed by this firm ; William Corey, Upper Bedford, Que., a "Walsh Improved" double-acting water wheel governor; Westport Milling Company, a 33-inch "Little Giant" water wheel. Wilson & Company recently supplied the latter firm with the necessary iron flumes for conducting water to this wheel and to their present 24-inch "Little Giant."

The St. Catharines & Niagara Power & Fuel Company, Limited, has been incorporated, with a capital of $40,000 and head office in Toronto. The promoters include Albert Bay, of St. Catharines, and J. R. L. Starr and J. L. Spence, of Toronto.

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SEND FOR TABLE OF CONTENTS.

SRARKS.

It is probable that the Winnipeg Electric Street Railway will be extended to St. Boniface.

The secretary of the Valleyfield (Quebec) town council has been requested to secure tenders for the installation of an electric plant.

The Union of Canadian Municipalities, at its recent convention in Ottawa, passed a resulution requesting the Dominion Government to pass a more satisfactory telephone bill.

The Winnipeg City Council have been offered the rights and privileges of the Lac du Bonnet Developing, Mining and Manufacturing Company at Lac du Bonnet Falls, together with an installation of 10,000 horse power electrical energy. The power is to be delivered to a transforming station in Winnipeg within two years. The price asked is $1,500,000.

A board of arbitration recently fixed the price to be paid by the corporation of Midland, Ont., for the existing electric light plant at $9,629. The owner of the plant has refused to accept the offer, on the ground that the town's arbitrator was its solicitor and a creditor of the town, and therefore incompetent to act. The courts have been asked to decide.

An attempt was recently made to injure the plant of the Humber Power & Light Company at Toronto Junction, when someone climbed along the stone wall of the Keele street subway and placed a piece of steel wire across the company's line so as to cause a short-circuit. Fortunately the generator at the power house was stopped before any injury was done.

The work of extending the power house of the St. John Street Railway at St. John, N.B., is progressing satisfactorily. In the new addition there will be installed a new engine of about 900 h.p. and a generator of 600 k.w., in addition to another combined unit of 400 h.p. After some of the smaller engines in the main power house have been removed a 1,100 h.p. Laurie engine will be installed. The company will then be in a position to supply the power needed on the west side.

The Electro-Manganese Company, incorporated by the New Brunswick Government last session, are said to have secured a lease for thirty years of the water power at Grand Falls, the object being to manufacture ferro-manganese from wad or bog ores. This ore has hitherto been of no commercial value, but an electric process is said to have been discovered recently by which it can be worked on a commercial basis. The company is capitalized at $1,500,000.

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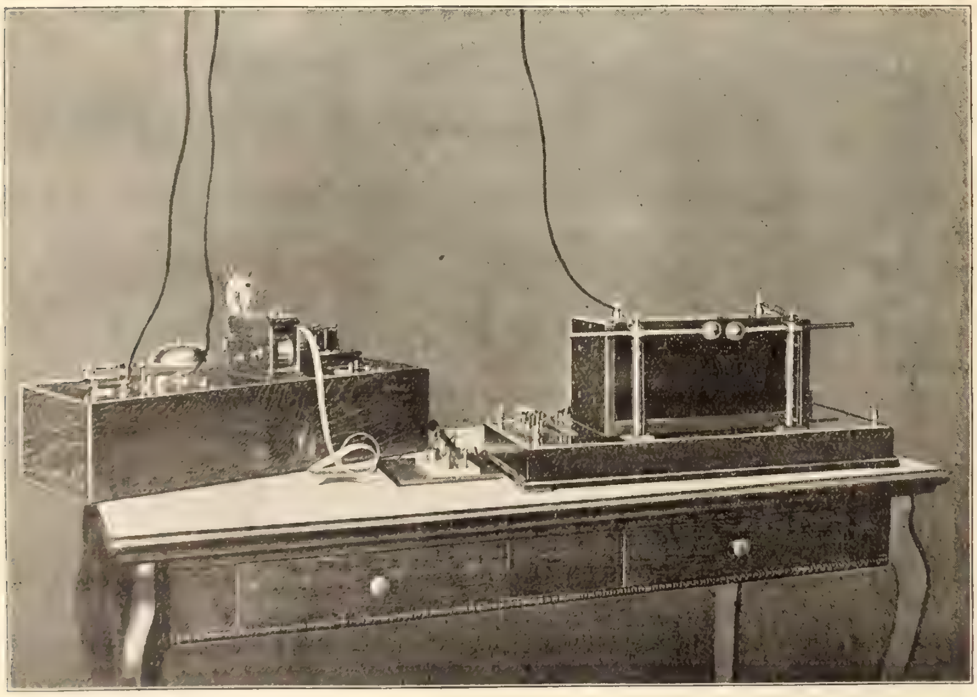

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SPARKS.

The Hinton Electrical Company, of Vancouver, are installing an electric light plant in the new Ludgate saw mill at Arrowhead, B. C.

It is said to be the intention of the promoters of the Berlin and Preston Street Railway to next year extend the road to Wellesley, Listowel and Goderich.

The new retail dry goods store of Ganong Bros. at St. Stephen, N.B., is to be lighted by their own electric plant. The building is steam-heated throughout.

The Bell Telephone Company have moved into new quarters at Victoria, B.C., the equipment of which is second to none in Canada. The central energy system, now employed in all the leading cities, has been adopted.

The Light, Heat & Power Company, of Lindsay, Ont., have made a proposition to light the streets of that town with sixty arc lamps of 1500 candle power each, the price to be $50 per lamp per year on a five-year contract.

The town of Berlin, Ont., recently took over the gas and electric light plants, paying $100,000 therefor. Improvements being necessary, the council has voted $70,000 to the Light Commissioners for the purpose. It is said that the steam engines will be replaced by coal gas engines. It is proposed to supply incandescent lights at a cent a night per light and to reduce the price of gas to $1 per thousand.

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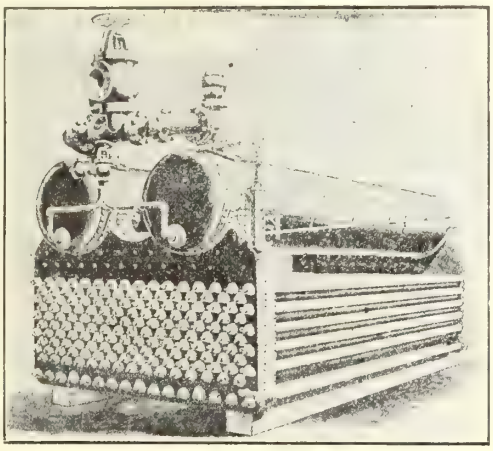

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ANNOUNCEMENT.

The Chair of Physics and Electrical Engineering at the Thomas S. Clarkson Memorial School of Technology has been filled by the Board of Trustees by the appointment of Byron Briggs Brackett, A.B. and A.M., Syracuse University: "Certificate in Electrical Engineering" and Ph. D., Johns Hopkins University. He is an associate member of the American Institute of Electrical Engineers and a member of the American Association for the Advancement of Science.

His teaching experience has been in Dickinson Seminary, Williamsport, Pa.; Adelphi Academy, Brooklyn, N. Y.; Eastern High School, Washington, D.C.: Electrical Engineering Laboratory, Johns Hopkins University, Baltimore, Md.; Union College, Schenectady, N.Y.; Rutgers College, New Brunswick, N.J., with which institution he was last connected previous to appointment to the Clarkson School of Technology.

His practical electrical engineering experience comprises the inspection and testing of all the cable manufactured for the U.S. Army during the Spanish-American war by the General Electric Company, of Schenectady, N.Y.; a year's work with the late Prof. Henry A. Rowland, of the Chair of Physics of Johns Hopkins University, in the development of the Rowland Printing Telegraph, with considerable experience in commercial electrical testing at various times.

A western system of electric roads is about to operate sleeping cars on its trolley lines which will be as luxurious as the Pullman on the steam road, and will offer in addition other conveniences which will add materially to the comfort and pleasure o the patrons of the road. The construction of the sleepers, while following the general scheme of the older type, will embody a number of new features. The cars will be somewhat lighter than the steam road sleeper, and during the day will be converted into parlor cars.

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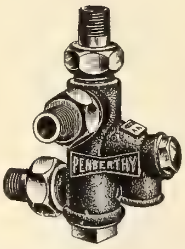

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SPARKS.

The Knight Bros. Company, of Burk's Falls, Ont., intend building a new dam for power purposes.

The Hamilton Cataract Power, Light & Traction Company, of Hamilton, Ont., have taken tenders on the erection of a brick and steel power house at DeCew Falls, near St. Catharines. The building will be 300 x 80 feet and 30 feet from the ground to the eaves. Four new generators of about 7,000 horse power will be installed therein. It is expected that the increased capacity will place the company in a position to supply the demand for electric energy for some time to come.

Mr. Louis Simpson, consulting engineer, of Ottawa, Ont., has recently visited the United States for the purpose of investigating the merits of the different electrical furnaces. He is confident that the electrical reduction of iron ores, and their conversion into steel, is a commercial possibility under the conditions which exist in the Ottawa valley and near the city of Ottawa. The difficulty seems to be only in the collection of sufficient data in order to decide which of the several different furnaces and processes are the best to adopt. Mr. Simpson is continuing his invesitgations with a view of utilizing some of the immense water power at the Chats Falls, within twenty miles of the city of Ottawa, for the purpose of producing iron and steel.

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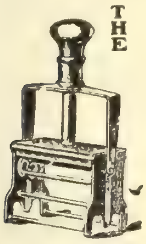

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PUBLICATIONS.

Prof. Alexander Ogg has translated into English Prof. Planck's book on Thermo Dynamics, which might be called an introductory text-book for students who have taken elementary courses in Physics and Chemsitry and are familiar with the elements of the Differential and Interval Calculus. It contains upwards of 300 pages and sells for 7 shillings 6 pence. The publishers are Longmans, Green & Company, 39 Paternoster Row, London, England.

"Engineering Preliminaries for an Interurban Electric Railway" is the title of a useful book by Ernest Gonzenbach. It contains the plans and recommendations embodied in a report on a proposed railway in the Middle West and is intended to show the way in which certain conditions were met in a certain case, together with the reasons which led up to the recommendations and plans submitted. The McGraw Publishing Company, 114 Liberty Street, New York, are the publishers.

SPARKS.

The ratepayers of Wingham, Ont., are to vote on a by-law authorizing the purchase by the council of the electric light plant.

On October 12th the ratepayers of Almonte, Ont., will vote on a by-law to raise the sum of $5,000 for the development of the water power and the purchase of additional electrical apparatus.

The Hamilton Cataract Power & Light Company have within the past few weeks replaced all the arc lamps in the city of Hamilton with lamps of the latest and most improved design, very greatly to the advantage of the street lighting.

The city council of Winnipeg have accepted the tender of the Canadian General Electric Company for the supply of electrical apparatus, at the price of $19,895. The Eugene Phillips Electrical Works will supply 12 miles of triple braided, water-proof wire at 16½ cents per pound f.o.b. Montreal.

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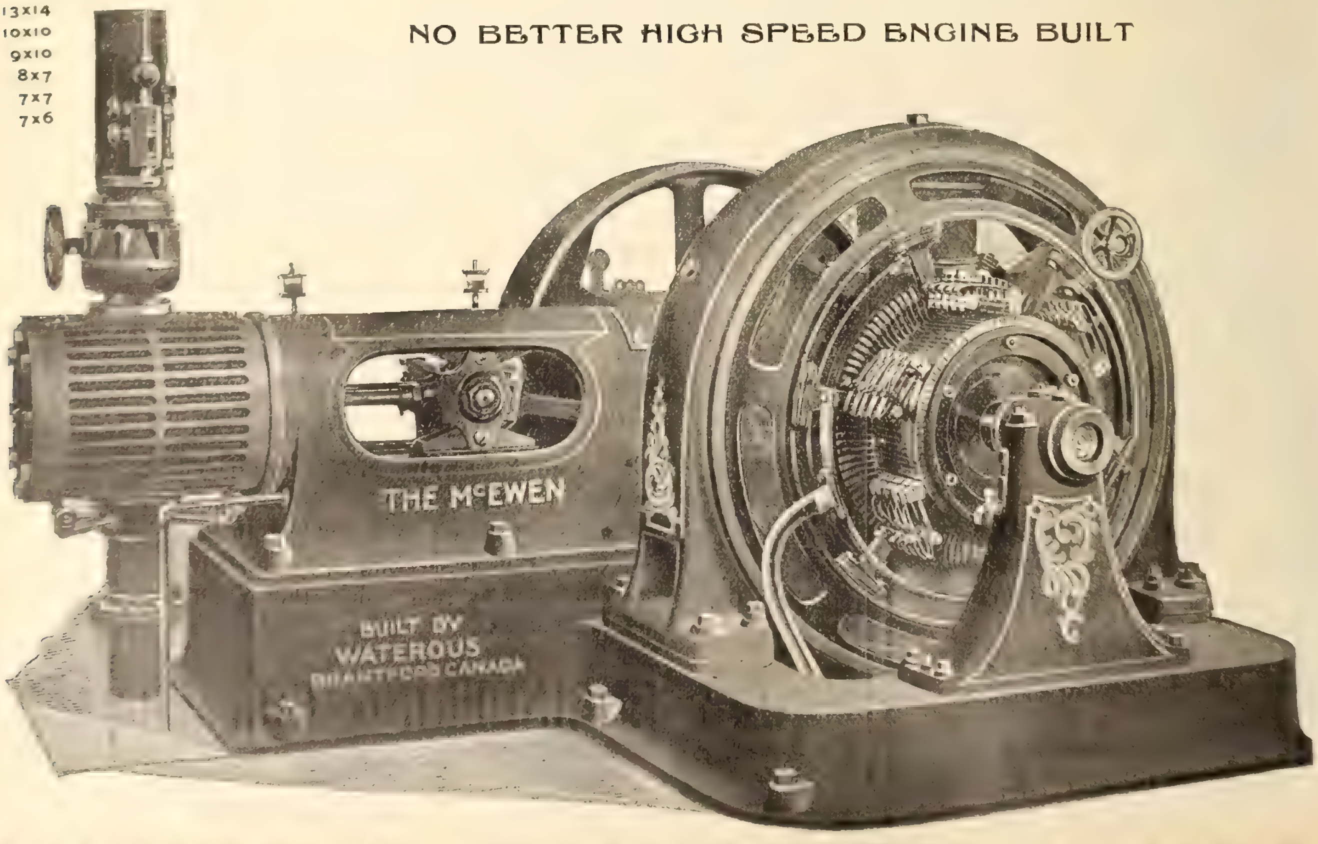

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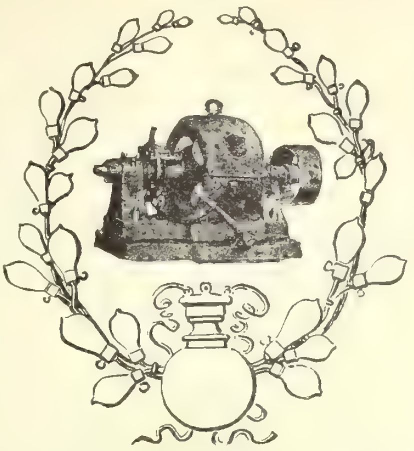

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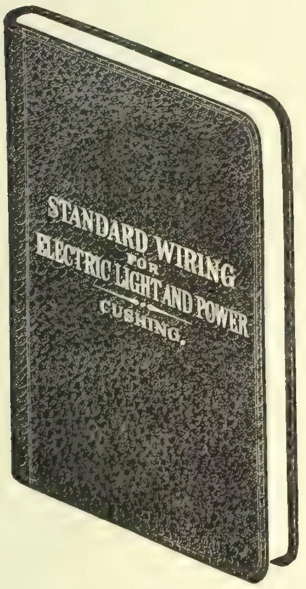

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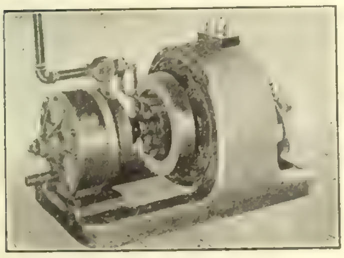
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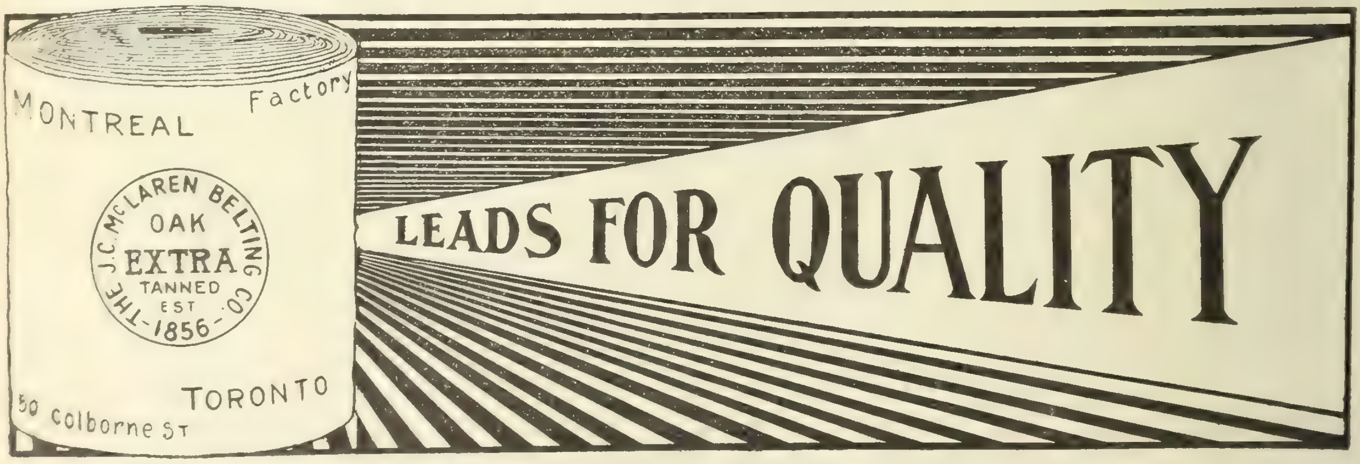

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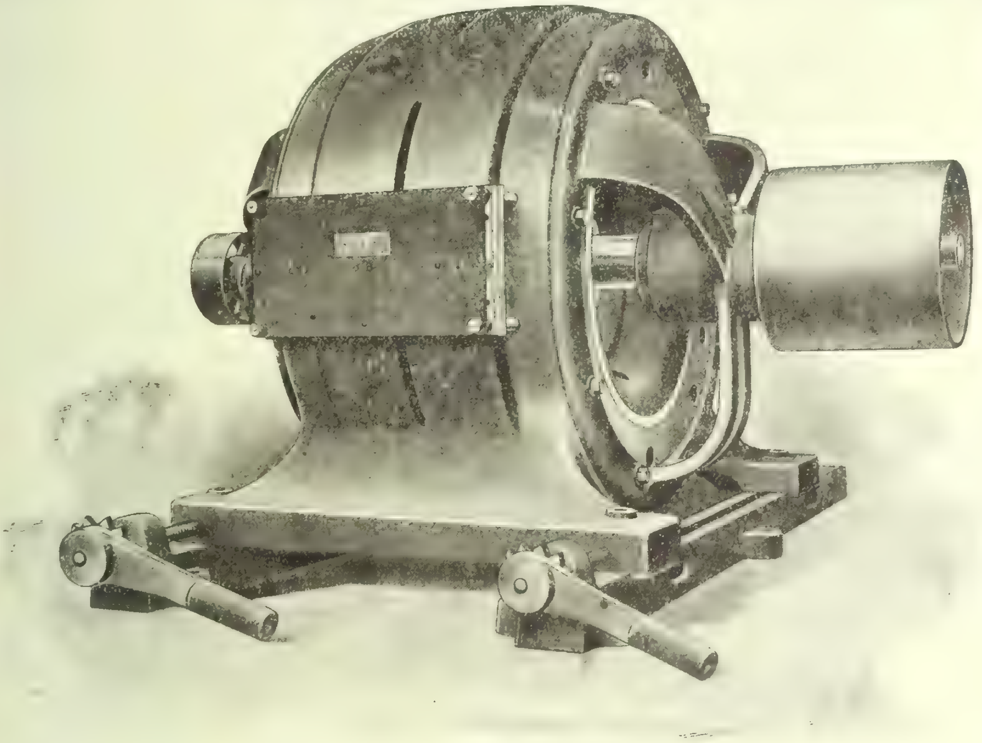

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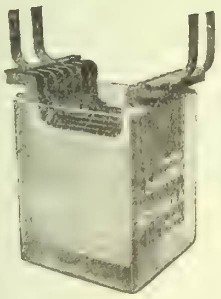

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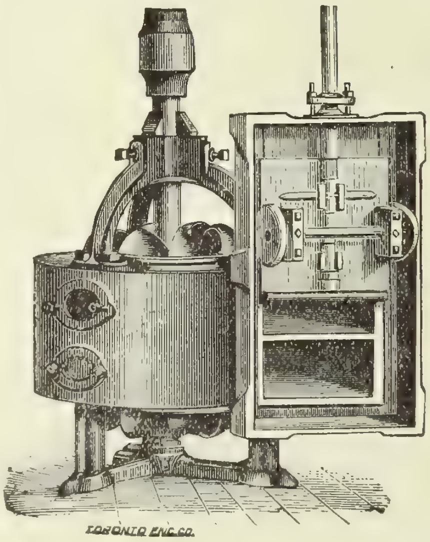
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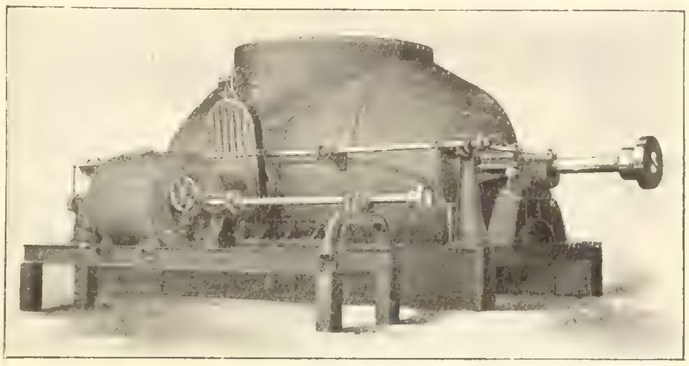

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SPARKS.

Barrie, Ont., is about to install an electric fire alarm system.

Mr. Peter Bell will build the extension to the power house at Current River for the Corporation of Port Arthur, Ont.

The ratepayers of Guelph, Ont., have voted in favor of taking over the radial railway, at a cost of $78,000. The vote was 532 for and 253 against.

Incorporation has been granted to the Toronto Automobile Manufacturing Company, Toronto, with a share capital of $50,000. The incorporators include Messrs. Charles Trow, John Noble and J. W. Siddall.

Mr. Robt. Ross, E.E., was engaged by the town of Perth, Ont., to report on the value of the plant of the Perth Electric Company. His figures were $4,033 for the electrical apparatus, exclusive of the Ritchie water power and appurtenances owned by the company. For their entire property the company have asked $10,800, and a committee of the City Council have recommended that an offer of $8,000 be made to them. If the offer is refused the Council threaten to discontinue the street lighting.

At a meeting of the Peterborough council on October 6th a contract with the Peterborough Light and Power Company was agreed to, by which the town gets 120 lights of 2,000 candle power for $46.66 per lamp per year. The Otonabee Power Company offered to supply the same power at $35 per lamp, but as the street railway service had been secured from practically the Peterborough Light & Power Company on condition of giving that company the lighting, the council did not consider the offer. It is said that legal steps will be taken to quash the contract.

Dr. H. T. Bovey, Dean of the Faculty of Applied Science at McGill University, Montreal, recently announced that the British Institution had just paid McGill a great compliment. Previously for any graduate outside of certain universities in England, Scotland, Ireland and Wales, to become qualified for membership in the British Institution, it was necessary to pass a specified examination. McGill has now been placed among those universities whose graduates are exempt from this qualifying examination, it being the first to receive this honor outside of the British Isles.

A controlling interest in the Humber Power & Light Company, which is capitalized at $100,000, is said to have been secured by the Stark Electrical Company, of Toronto, and as a result President Samuel Nesbitt, A. C. Morris and H. A. Hurd are replaced on the directorate of the former company by Hon. John Dryden, Hon. Geo. E. Foster and Mr. A. Stark. The Stark Company propose to demonstrate at the Junction its system of light, power and telephone by one wire.

MOONLIGHT SCHEDULE FOR DECEMBER.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Dec. 1	2 00	Dec. 1	6 30	4 30
2	3 00	2	6 30	3 30
3	4 00	3	6 30	2 30
4	No Light	4	No Light	
5	5 00	5	7 30	2 30
6	5 00	6	8 30	3 30
7	5 00	7	9 30	4 30
8	5 00	8	10 40	5 40
9	5 00	9	11 50	6 50
10	5 00	11	1 00	8 00
11	5 00	12	2 00	9 00
12	5 00	13	3 00	10 00
13	5 00	14	4 15	11 15
14	5 00	15	5 15	12 15
15	5 00	16	6 30	13 30
16	5 00	17	6 30	13 30
17	5 00	18	6 30	13 30
18	5 00	19	6 30	13 30
19	5 00	20	6 30	13 30
20	5 00	21	6 30	13 30
21	5 00	22	6 30	13 30
22	7 00	23	6 30	11 30
23	7 45	24	6 45	11 00
24	8 45	25	6 45	10 00
25	9 45	26	6 45	9 00
26	10 45	27	6 45	8 00
27	11 45	28	6 45	7 00
29	0 45	29	6 45	6 00
30	1 45	30	6 45	5 00
31	2 45	31	6 45	4 00
		Total............		250 00

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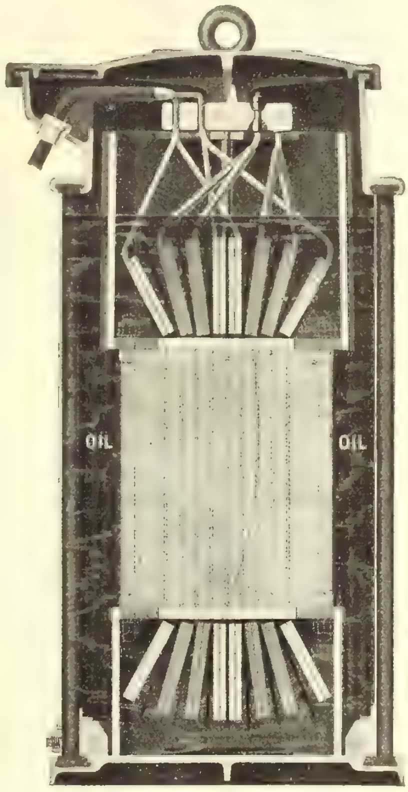

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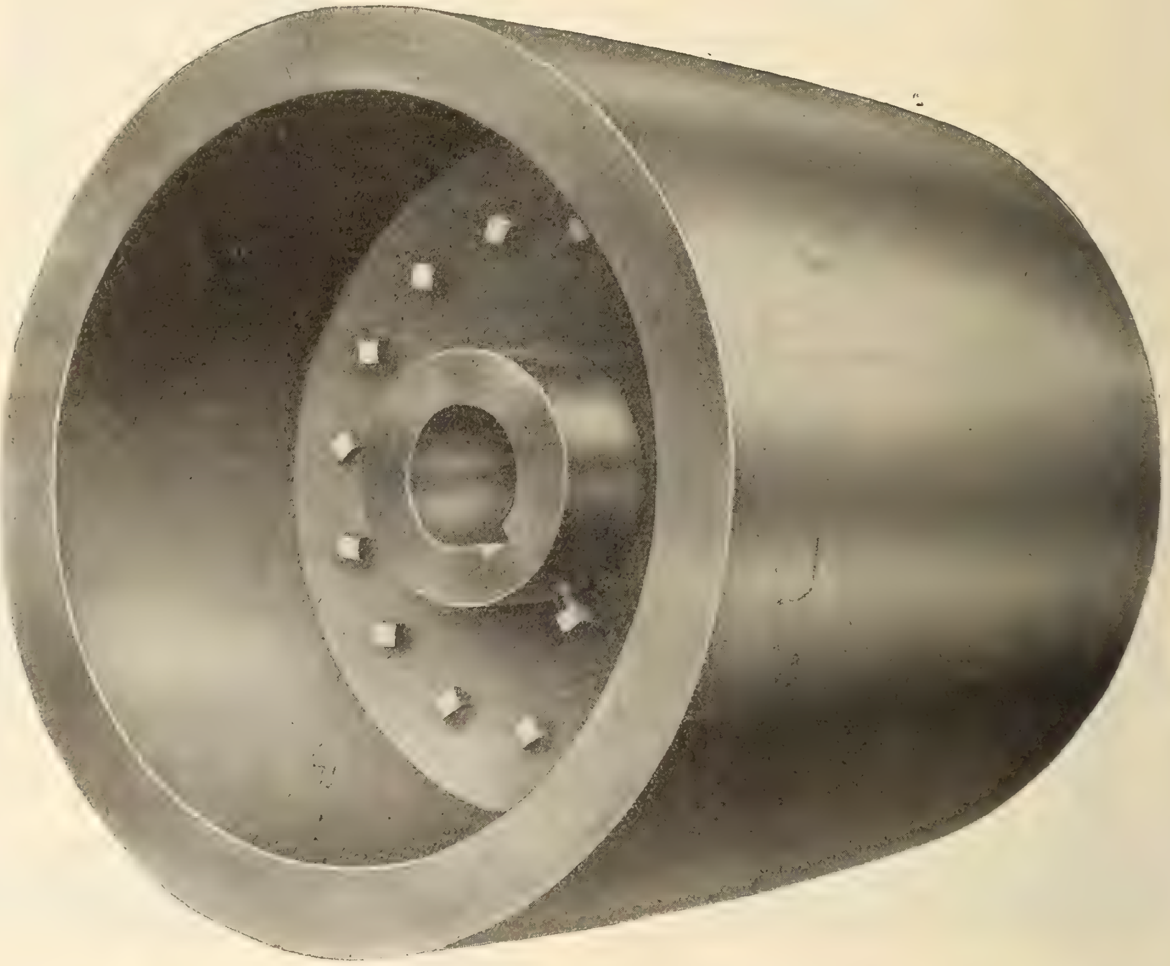

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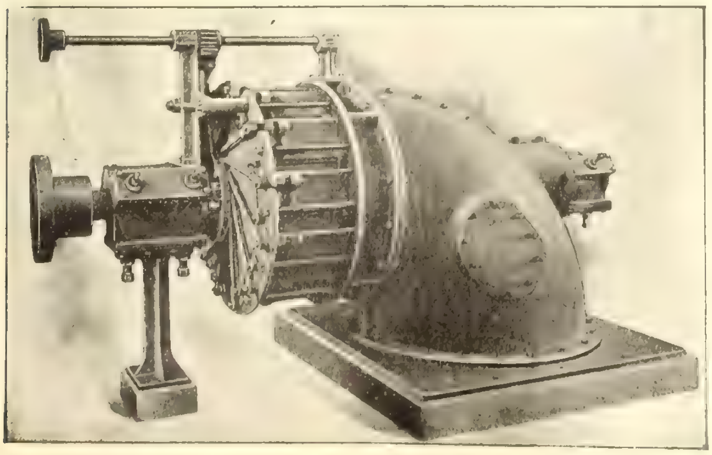

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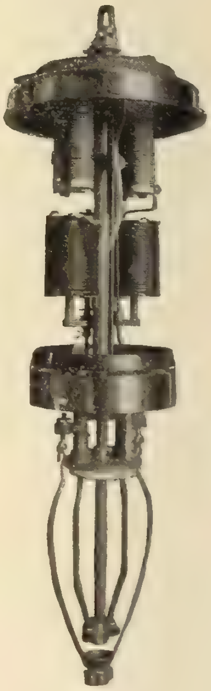

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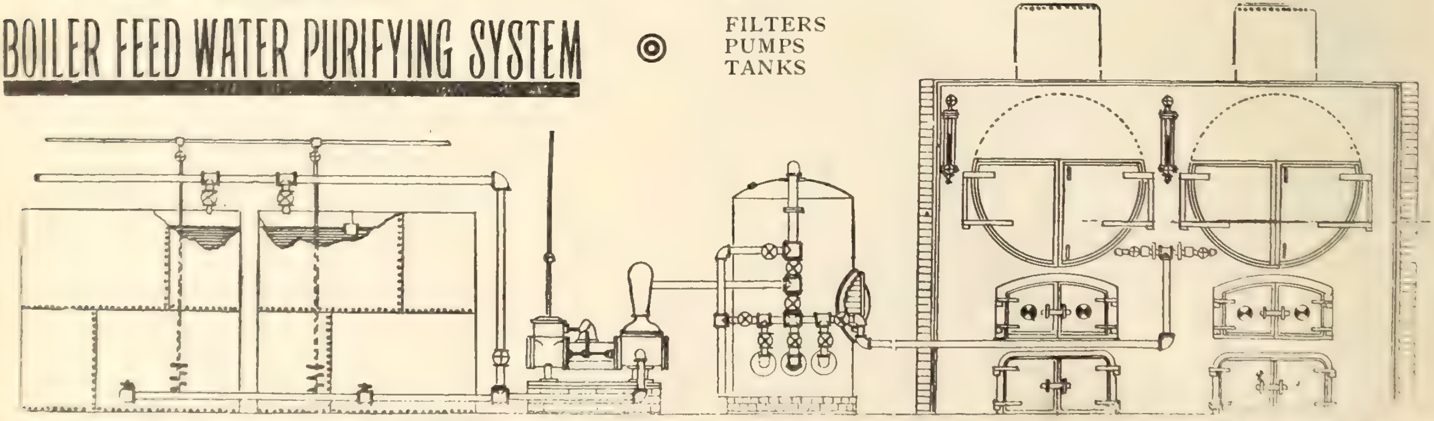

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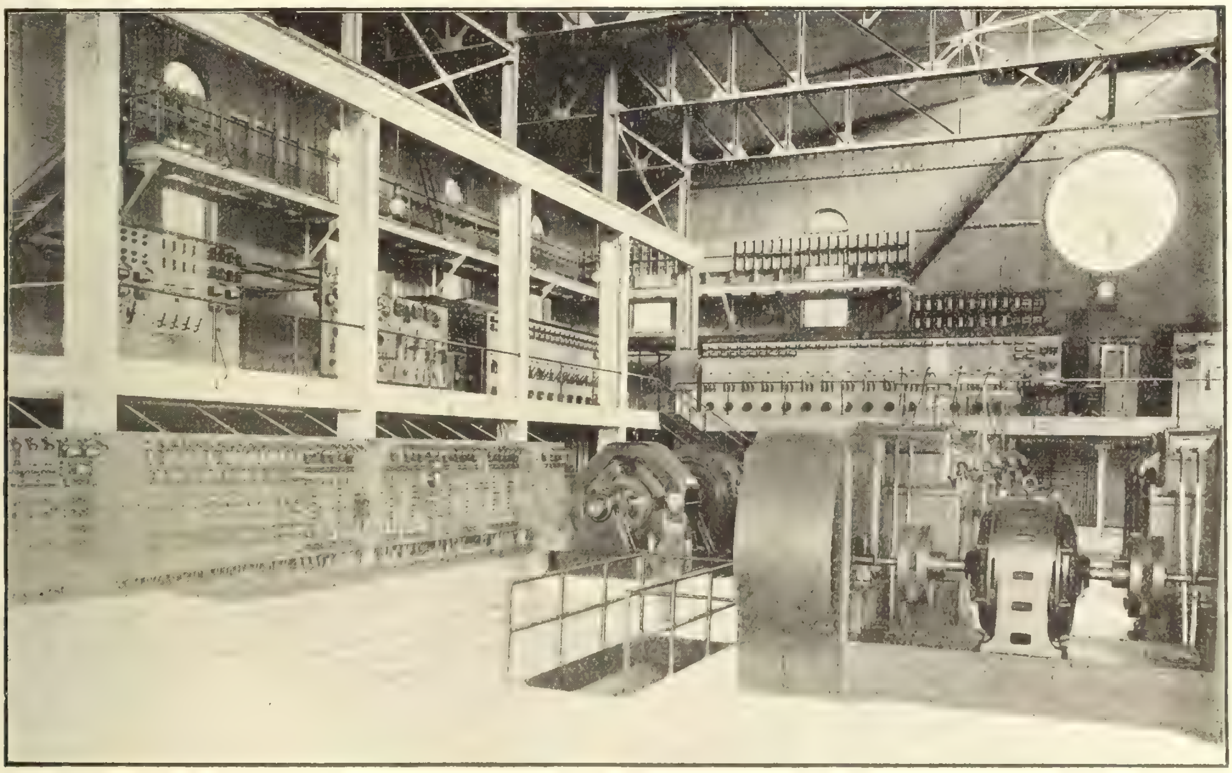
NEW TRANSFORMING AND DISTRIBUTING STATION OF THE MONTREAL LIGHT, HEAT AND POWER COMPANY.

By J. A. Burnett.

Coincident with the reconstruction of the Chambly hydraulic and electrical development and the acquisition by purchase of the Lachine Rapids, Hydraulic and Land Company on behalf of the Montreal Light, Heat and Power Company, the management of the latter company decided to abandon their 10,000 volt lowering transforming station on Prince street and to construct a suitable new transforming and distributing station of such size and capacity as to provide for future requirements. The demand for light and power in Montreal and its suburbs has within late years increased at a phenomenal rate.

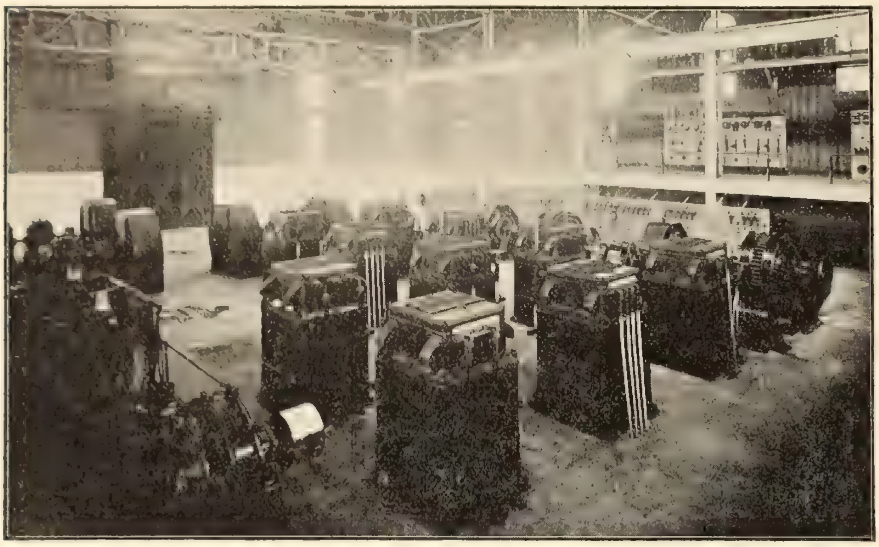


Central Station, Montreal Light, Heat & Power Company—View Showing Induction Motor Blower Units and Synchronous Motor Generator Sets ; on Gallery Controlling Panels and 27-Panel Feeder Switch-Board

Montreal being a city with favorable advantages for manufacturing, has seen existing manufacturing industries largely extended and new ones from time to time inaugurated. The use of electric power is favorably considered for such industries, especially as the Montreal Light, Heat and Power Company are in a position to and do quote rates to large users of power as to in most cases supplant steam power. Apart from the mere question of cost, the use of electric power presents such features as steadiness of operation, reliability and freedom from interruption, minimum expense for attendance, and economy of floor space. Such characteristics have therefore brought about the introduction of electric power in large industrial establishments in the city of Montreal and vicinity.

Prominent among such users of power are: Montreal Street Railway Company, using 4,000 k.w.; Dominion Cotton Mills Company, 2,500 k.w. ; Canadian Pacific Railway Company, general shops, 1,500 k.w.; Canadian Rubber Company, 1,000 k.w.; Montreal Water and Power Company, 1,000 k.w.; Montreal Water Works, municipal, 500 k.w.

The above represent the larger users of power and the list is continued down to small but very numerous users, having motors for ice-cream freezers, dental laboratories, fans for cooling, horse clippers, wood chopping establishments, church organs, laundries in private residences, and elevators in houses where the inmates prefer such means of ascending indoors to the old-fashioned and more laborious method of walking upstairs. Altogether the application of electric power in Montreal is getting to be well nigh universal, and in the case of such establishments as the Dominion Cotton Mills Company it is an impressive sight to view the large mills of this concern, with some 1200 operatives, being entirely operated by electric power with a distant water-power as the prime mover.



Central Station, Montreal Light, Heat and Power Company—View Showing Ten 2,750 K.W. Transformers, Travelling Crane and D.C. Switchboard Panels.

The electrical power generated by water-power at Lachine, Chambly, and Shawinigan, and distributed by the Montreal Light, Heat and Power Company for lighting and industrial purposes, yearly supplants the consumption of the large estimated amount of 175,000 tons of coal, or 560 tons for every working day in the year, thus introducing into municipal matters an economic factor of basic importance. The necessity, therefore of a suitably designed transforming and distributing station for such a system is thus made apparent.

This station, designated by the company owning it Central Station, and one of the largest of its kind in the world, was commenced August 19, 1901, and by May, 1902, apparatus was being installed therein, work having been continued throughout the winter, except for a few weeks' interruption due to excessively cold weather.

The building occupies the block bounded by Wellington, Prince, Ottawa and Queen streets, a situation well adapted for distributing purposes. It is strictly fireproof and is at all points at least 80 feet distant from any neighboring buildings. The windows are provided with steel framings and 1/4″ thick wired glass panes. Wood has as far as possible been carefully eliminated thoughout this building, only the doors at the Ottawa street end of the building being composed of this material.

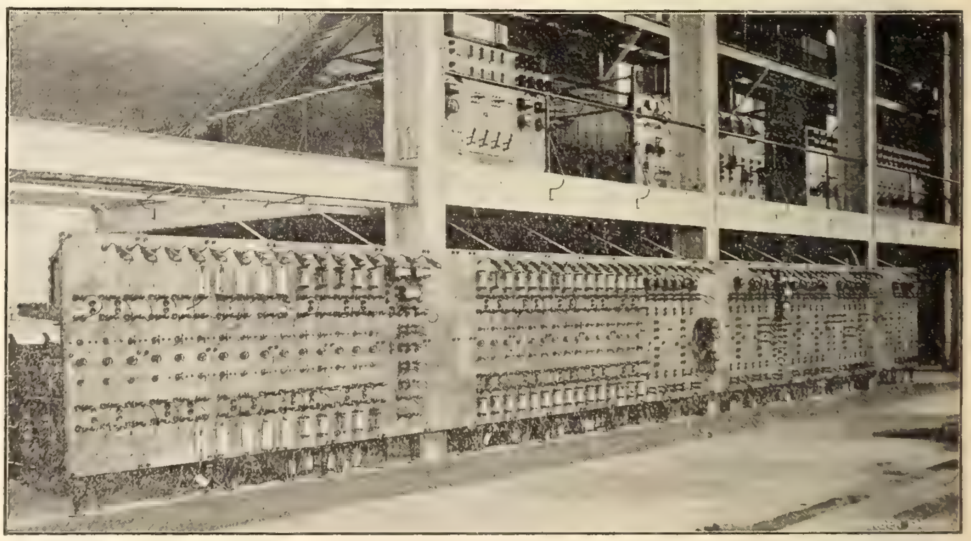
The heating of this structure is furnished to a great extent by the transformer internal losses, which at time of full load approximate 500 k.w.

Other features of this building are the ample width of switchboard galleries, 21 feet, and the liberal amount of daylight when such is available. The artificial lighting consists of rows of incandescent lamps suspended from the roof trusses and a row of a.c. arc lamps suspended over the switchboard galleries. An auxiliary gas supply is connected to gasoliers attached to the gallery hand rail. These are kept lit after dark, so that under no circumstances will the building be put in total darkness.

The switchboard gallery flooring is composed of 2½ inch slate laid on 15 inch I floor beams, spaced 4 ft. 2 in. centers. The main and basement flooring is of granolithic composition.

The outside walls of the building are constructed of Laprairie pressed brick. Inside for 10 feet is provided white enamel brick, and above that Milton brick of a pleasing buff color. The roof is very substantial, being 10 inches thick of terra-cotta, over which is applied a waterproof asphalt roof 1 inch thick. The building interior measures 118 feet x 122 feet 6 inches.

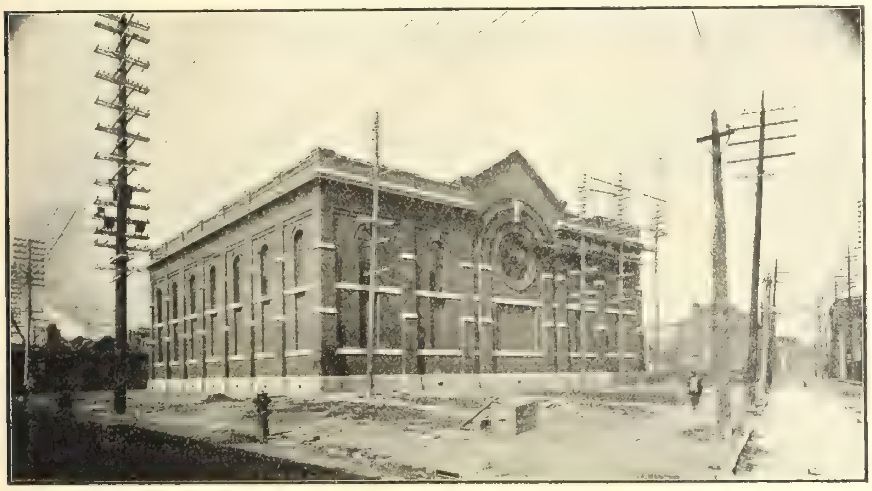
The apparatus installed comprises a 25,000 volt high tension, a 4,800 volt transformer switchboard, and a 4,800 volt distributing feeder switchboard. The high tension switchboard comprises four incoming line and five transformer primary panels. The transformer switchboard comprises five operating and two total output instrument panels. The distributing feeder switchboard comprises sixteen and eleven panels, each capable of controlling 1,000 k.w. at 4,800 volts. The circuit breakers with which these panels are pro.



Central Station, Montreal Light, Heat and Power Company—View Showing A.C. Arc Lighting Switchboard; on Gallery, A.C. Switchboard Controlling Transformer Blower Motors, D.C. Switchboard Panels, and 11-Panel A.C. Feeder Switchboard; on Upper Gallery, Lightning Arresters.

vided are automatic, the final break taking place in oil. These circuit breakers are intended to open under short circuit conditions and are inclosed in a brick walled cell, with 2 inch soap-stone cover. This feature is shown in Fig. 2.

On the ground floor and immediately under the distributing switchboard is located a set of 27 circuit breakers, similiar to those above. These are intended to handle grounded or defective circuits. This set is called the "emergency board." Each feeder panel is provided with a time element overload relay. These open the circuit-breakers under overload conditions. A feature of this board is the interlocking mechanism arrangements. This insures that a defective or grounded feeder must be removed from the main bus-bars before being thrown on to the emergency bus-bars or vice-versa.



Exterior of Central Station, Montreal Light, Heat and Power Company—This View Shows Exit of Overhead Feeders.

The high-tension switchboard is merely a selector board and its switches are only intended to open the transformer primaries under no secondary load conditions. The transformers are controlled at their low tension ends through single-pole, oil-break circuit-breakers, each of 1,200 amperes capacity.

The high-tension switchboard is connected to the transformer primaries by means of a three conductor No. 0000 B. & S. gauge paper insulated cable, designed for 25,000 volts working. A section of this cable is shown in Fig. 3. The outside diameter of this cable is three inches. There is some 12,000 feet of this cable in use on the incoming lines, between the Central Station and the Victoria Bridge, and comprising part of the Chambly transmission line. In the Central Station this cable is run in brick trenches, as shown in Fig. 4.

A noticeable feature of this equipment is the bank of voltage lowering transformers, ten in number. These are of the air-cooled type, no oil being used for insulating; they are rated at 2750 K.W. capacity each, and are of the following dimensions: Height, 8 ft. 6 in.; base, 4 ft. 7 in. x 4 ft. 11 in.; weight, 24,000 lbs. They are the largest transformers in the world. A view of one of these transformers is shown in Fig. 1.

The heat generated by the iron and copper losses is taken away in the following manner: Three sets of induction motor and blower units are installed over a brick air chamber, measuring 65 ft. x 37 ft. x 8 ft. high. These blowers, six in number, have 32 in. x 32 in. down draft discharge outlets, and deliver air into the chamber at about ¾ to 1 oz. pressure per square inch. This air is blown down into the air-chamber, and then rises through the bases of the transformers, percolating through the copper and iron interior structure. This is shown in Fig. 5. The transformer bases have an opening 3 ft. 5 in. x 3 ft. 9 in. to permit of free air circulation. The permissable temperature rise for continuous operation is 35 degrees C. above the surrounding air. The ten transformers require 60,000 cubic feet of air per minute for cooling. This air is used for heating the building, as before mentioned.

The transformers are permanently connected in pairs; the primaries three phase 25,000 volts, the secondaries 2,400 or 4,800 volts, two phase, which is the system now in use by the Montreal Light, Heat & Power Company for distributing purposes. Each transformer secondary requires four 1,000,000 c.m. cables to carry its output to the transformer switchboard bus-bars. In running these cables, care had to be exercised to avoid iron clamps, due to the resulting heating effects. All bushings, etc., are of non-magnetic material.

This station also contains a complete switchboard for the alternating current arc street lighting, there being 30 constant current transformers and regulators, each regulating and supplying a fifty lamp circuit. Two motor-generator sets are provided for the D. C. power service. These sets consist of a Type 13 S. K. C. synchronous motor direct connected to a 200 K. W. D. C. multipolar 250 volt generator. These sets have switchboard panels separate from the A. C. switchboards before mentioned. A novel form of insulating

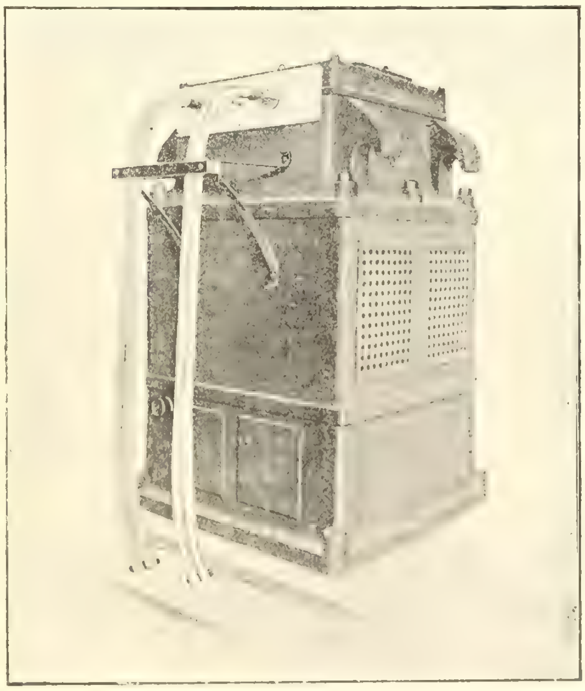


Fig. 1.—2,750 K. W. 25,000 Volt Westinghouse Air Blast Transformer The Largest Transformer in the World.

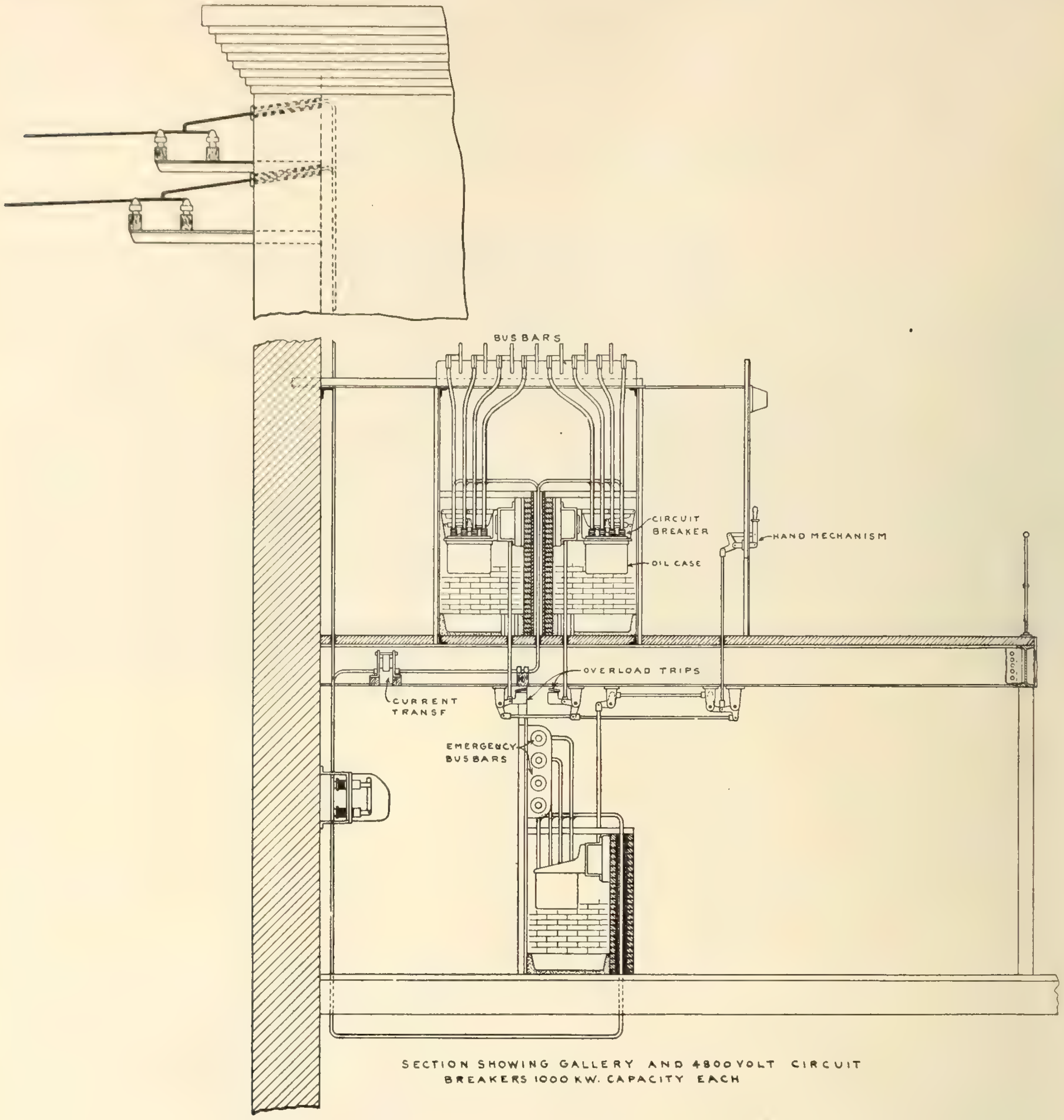


Fig. 2.

and flexible coupling is used on these sets and is shown in fig. 6.

The upper gallery shown on the illustration is intended for the lightning arrester equipment.

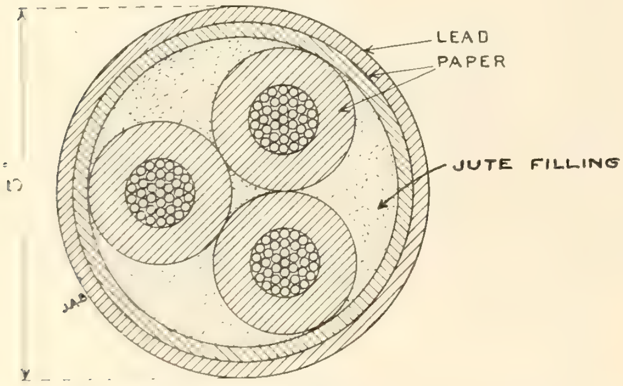


Fig. 3.—25,000 Volt 3 Conductor No. 0000 B & S Gauge Paper Insulated and Lead Covered Cable.

A 15-ton capacity three-motor electric overhead travelling crane with a 73-foot span is used for picking up and handling station apparatus. A roomy basement is also provided with 8 feet headroom. This basement contains cable ducts and trenches for the switchboard and feeder cables. Lavatories and clothes lockers, as well as a gas stove for heating, are provided for use of the station attendants.

The output of this station is at present 27,500 k.w. and floor space is reserved for an ultimate installation of sixteen lowering transformers, or 44,000 k.w. Ample space is reserved for any desired switchboard extension considered necessary.

This station is served from the following sources :

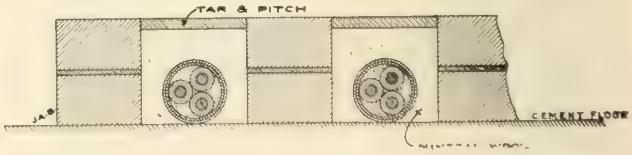


Fig. 4.—Method of Running 25,000 Volt Cable.

Lachine, Chambly, and Shawinigan ; the daily load reaching 25,000 k.w. around 6 p.m. A steam reserve of 5000 k.w. is also available and connected by suitable feeders to the distributing switchboard busbars. This steam reserve is contained in a station distant about 500 feet from the central station, and a smaller plant of about 1000 k.w. is contained in a station on Water street about two miles distant.

Fig. 2 shows the method adopted for the exit of the overhead lines. A series of floor tubes about 24 inches long were inserted in the walls during construction, and through these the feeders were run, the outside lines being deadened on the outside fixtures.

Figures relating to capacity and floor area are of interest. The floor area of the central station is 14,500 feet and the ultimate capacity 44,000 k.w., giving an output per square foot of floor area of some 3 k.w. The sources of energy available through this station are as follows: Lachine water power, present capacity 6,000 k.w., distance 5 miles; Chambly water power, 15,000 k.w., distance 17 miles; Shawinigan water power, 10,000 k.w., distance 85 miles; steam reserve, Queen street station, 4,000 k. w., 500 feet; steam reserve, Water street station, 1,000 k.w., 2 miles.

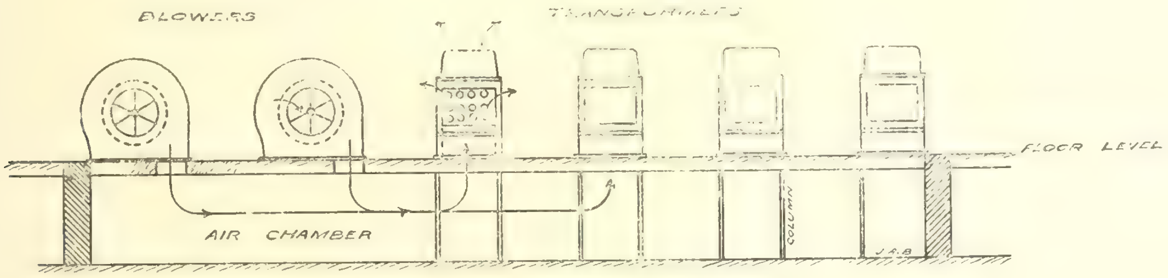


Fig. 5.—Diagram Showing Air Circulation.

In conclusion it may be stated that no expense or effort has been spared on the part of the Montreal Light, Heat and Power Company to make this installation a perfect one of its kind.

THE STEAM TURBINE.

Before the mechanical section of the Canadian Society of Civil Engineers in Montreal Prof. Homer M. Jaquays recently read an interesting paper on the steam turbine. He pointed out that the turbine is the oldest type of steam engine, and has always attracted more than an ordinary amount of attention, which has considerably increased since 1884 and 1889, when patents were awarded to Hon. Charles Algernon Parsons and Dr. Gustave DeLaval, respectively. Trevithick, Pilbrow, Wilson, and a few others grasped the salient features of the modern turbine, but it needed modern workshop facilities with the attendant accuracy and attention to detail to make it a commercial success.

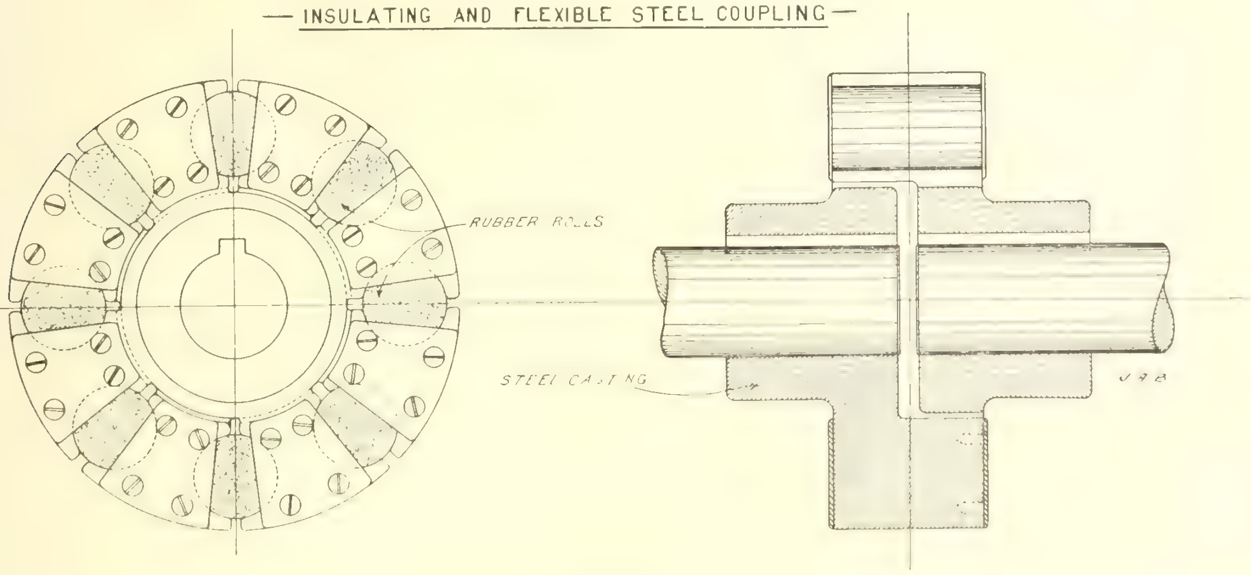


Fig. 6.

Previous to the last decade conservative engineers in general, undoubtedly, looked askance at rotary engines and turbines; but it needs only a glance at the modern turbine to perceive mechanical features which must meet with approbation. The velocities dealt with when working in steam are immensely greater than can ever be experienced with water. Thus, with a head of 220 feet the velocity of the water entering the turbine could not exceed 113 feet per second. In the case of the DeLaval type, however, where the steam expands in a diverging nozzle from initial pressure to condenser pressure, it is estimated that velocities of 4,000 feet or more per second must be employed. After carefully describing the differences between the various turbines, Prof. Jaquays went on to give comparisons and results attained in experiments running over extended periods with the different types.

After the paper an interesting discussion took place which brought out the wonderful advances made in the steam turbine, so that its economy is now equal to the best reciprocating engines. It is, however, limited by the fact that its high speed renders it applicable only to fast running machinery and in the smaller sizes it is not very economical. The turbine engine, however, has many advantages, it has less weight, and hence requires the minimum of foundation; it requires very much less space; there is practically no vibration. Among its chief recommendations are the facts that it requires no special attention and little lubricating, and last, but not least, its extreme simplicity of parts.

Some of the aldermen of Hull, Que., favor the introduction of electric power for the operation of the waterworks plant.

Kingston capitalists have purchased the Mississippi Falls water power located about eight miles east of Mississippi Station, and will likely take steps to develop the power and transmit it to Kingston and other points. It is said that 8,000 horse power can be obtained.

THE CANADIAN WESTINGHOUSE COMPANY.

At a meeting held in Hamilton on October 10th, and presided over by Mr. George Westinghouse, the Canadian Westinghouse Company, Limited, was organized, with a capital of $2,500,000. The new company is a consolidation of all the Westinghouse interests in Canada, which heretofore had been conducted individually. It will take over all the property, patents and other interests of the succeeded companies, including the sales organization and business of Ahearn & Soper, of Ottawa.

The following board of directors have been elected: George Westinghouse, of Pittsburg; C. F. Size, of Montreal; H. H. Westinghouse, George C. Smith, Frank H. Taylor, L. A. Osborne, all of Pittsburg; Thomas Ahearn, of Ottawa; Hon. J. M. Gibson, of Hamilton; W. Y. Soper, of Ottawa; Paul J. Myler, of Hamilton.

The Executive Committee as formed will consist of the following gentlemen: H. H. Westinghouse, F. H. Taylor, L. A. Osborne, George C. Smith, and W. Y. Soper. The officers as elected are: George Westinghouse, president; H. H. Westinghouse, 1st vice-president; F. H. Taylor, 2nd vice-president; Paul J. Myler, general manager and treasurer; John H. Kerr, secretary.

Mr. Paul J. Myler,
General Manager Canadian Westinghouse Company.

While only the ten directiors named were elected, the Board when complete will consist of fifteen members, the remaining five to be named from among the Canadian gentlemen interested.

Ground has already been broken for the new works to be built in Hamilton and the erection of the buildings will follow as fast as possible under the direction of Westinghouse, Church, Kerr & Company and Mr. F. A. Merrick, superintendent of the electrical department of the Canadian Westinghouse Company.

The Canadian Company took over the business of the Westinghouse Company on November 1st. The principal sales offices are located in the Lawlor Building, corner King and Yonge streets, Toronto, and in the Liverpool, London and Globe Building, Montreal. Mr. T. C. Frenyear, of Buffalo, has been placed at the head of the sales organization as sales manager, and is now located at the Toronto office. Mr. Henry D. Bayne has been appointed manager of the Montreal office, while Mr. T. F. Dryden will continue in charge of the Toronto district sales and will be located at the Toronto offices.

When it is considered that the Westinghouse Manufacturing Company alone have had sales in the Dominion to about $2,000,000 annually, the importance of this addition to the Canadian industry cannot be overestimated. The business in Canada has grown to such proportions that, in line with the policy of Mr. George Westinghouse to establish works in the countries served, the Canadian Company was essential to the proper care and conservation of the demands and interests of the Dominion. No doubt it will soon become one of the largest manufacturing establishments in this country.

TREATISE ON THE NERNST LAMP.

A valuable treatise on the Nernst lamp has just been compiled by Mr. A. J. Wurts, electrical engineer of the Westinghouse Company, who has developed the Nernst lamp to its present practical efficiency. It is a text book of the highest character and will prove of value and interest not only to the electrical profession but also to students of electrical science. The construction and characteristics of the Nernst lamp are explained in an able manner, and voltage charts are shown of particular interest. The following useful notes concerning the lamp are given:

(1) The heater of a Nernst lamp will be cut into circuit in a six glower lamp when four glowers are burned out, in a three glower lamp when two glowers are burned out, in a two glower lamp when two have burned out, and in a one glower lamp when its glower has burned out.

(2) The greater the number of alternations, the longer the life of the glower.

(3) It is not desirable to place a Nernst lamp inside of an outer globe. The Nernst lamp is a finished lamp in itself, and the shell or housing of a Nernst lamp will cast a shadow on the outer globe, producing an inartistic effect.

(4) The power factor of a Nernst lamp is 100% and the watt consumption is equal to the product of the volts times the amperes.

(5) A 220 volt lamp runs at the same efficiency as a 240 volt lamp, but the latter will have a correspondingly higher candle power and watt consumption.

(6) If all the distinguishing marks on two Nernst lamp bodies are removed, the size of the ballast wire will quickly determine whether the lamp belongs to the 110 volt or the 220 volt type, the smaller wire indicating the higher voltage.

(7) The voltage of a single heater tube for a 220 volt lamp is 110; the voltage of a single heater tube for a 110 volt circuit is 55.

(8) Glassware should be attached loosely to the lamp bodies, allowing for expansion and contraction.

(9) Large globes should be protected with a wire net.

Mr. Charles Copeland has purchased the electric light plant at Elmvale, Ont.

The Star of the East Gold Mining Company have purchased from the Canada Company the old Snyder Depot property, mill site and water power on the Mississippi river at foot of Lake Wassanga, Frontenac county. It is proposed to repair the dam and install an electric plant for the operation of the mine, one mile distant.

QUESTIONS AND ANSWERS

1. When measuring the power taken by an induction motor which has condensers on it, where should I connect in my instruments, between the service and the condensers, or between them and the motor?

Ans.—If you are using a wattmeter, and want to measure very accurately, and to get the power consumption of the motor only, the instrument should be wired in between the machine and the condensers. On the other hand, if you are trying to get a commercial reading, you should include the power taken by the condensers as well, when the meter should be connected into the service wires. This will give a slightly larger reading than that of the motor only, but a customer should pay for the losses in the condensers just as much as for the power consumed in the motor. If you are using an ammeter it must be put into the service wires, otherwise you will get a reading which may be very deceptive, as the current in the lines to the motor between it and the point where the condensers are tapped in, is usually considerably larger than that in the service wires.

2. Will you please explain what there is peculiar in the Meridian lamp that makes it of such a high efficiency. Why cannot all incandescent lamps be made of the same efficiency ?

Ans.—The Meridian lamp is really an ordinary incandescent lamp, that is, it has a filament of the same composition as the other types, but the secret of high efficiency lies in the addition of a reflector to the upper half of the bulb. This sends all the light rays which ordinarily would go up, and thus be wasted, down into the space below the lamp. The light in this direction is thus much greater, or in other words, is of larger candle power for the same energy consumption, which constitutes high efficiency. As a further aid to the vertical distribution of the rays of light, the filament is placed so that its axis is mainly horizontal, instead of being vertical, as in the majority of the other types. All incandescent lamps are not made after this pattern because it is a patented article, and further, a large part of them are used for general illumination, that is, to throw light in all directions, whereas the Meridian sends most of it directly downwards, and over a comparaitvely limited area.

3. What kind of tie wire is best to use when putting up an aluminum line ?

Ans.—Just as you use a copper tie wire for tying a copper line, it is considered desirable to use an aluminum tie if the line is of that matter. This is done bacause if you used dissimilar metals it might give rise to an electrolytic action at the points of contact, more especially if there were any salts present in the air. If the main line wires are bare, the ties would be bare also, as there is no object in going to the expense of weatherproofing them. On the other hand, if the line is weatherproof the ties should be covered in a similar way, as a bare tie would soon cut into the covering on the line wire.

4. I am interested in a company which is going to put up a three-phase transmission line about twelve miles long, the pressure being 10,000 volts. Which kind of insulator would be the best for use to use, glass or porcelain ?

Ans.—It is impossible to lay down a hard and fast rule, each style having its good points. Porcelain is stronger and thus will stand heavier blows without breaking ; but the glaze sometimes cracks under the action of extreme cold, and thus destroys the insulation. On the other hand, it does not so readily condense moisture on its surface, and so maintains, on the whole, somewhat better insulation in damp situations, though where there is much smoke, such as along railroads or in cities, a film of dirt soon covers any style of insulator, and thus makes them all more nearly equal. Glass has the advantage of passing more light through it, which in some situations becomes a value, as it tends to prevent cocoons and cobwebs forming in the grooves. On the whole, unless your plant presents some very special features, we do not think that you would find much difference between one type and the other—and glass is cheaper.

5. Why is there such a difference between carbons for enclosed arc lamps and those for the open type ? What would happen if you used common carbons in an open arc lamp ? What are cored carbons used for ?

Ans.—The difference in structure is that the ordinary carbon is made of petroleum or gas retort coke, whereas those for enclosed lamps are composed principally of lamp-black. The more expensive construction is necessary because the ordinary carbon contains impurities which would blacken the enclosing globe too quickly, besides burning at a lower temperature and thus not giving so much light. Further than this, foreign matter of any kind is apt to cause flaming and hissing. Another point is that the ordinary carbon is not straight enough, nor is the diameter sufficiently uniform, to allow it to go through the gas cap on an enclosed lamp without either sticking or else letting too much air through. Cored carbons are used on alternating lamps to prevent the arc from wandering round the edge of the carbons, the current following the soft core, which is of lower resistance than the rest of the carbon. They are often used as well in direct current searchlights, where it is necessary to keep the arc as closely as possible to one definite point.

6. Does it matter in what lead you put the ammeter on a compound wound dynamo, and also the series field?

Ans.—When operating a single dynamo, it makes no difference whether the ammeter is on the positive or the negative side, but when more than one are in service they must be put in the lead opposite to the series field; if put on the same side as the latter they may not record correctly because part of the load on one machine or the other may go through the equalizer. It makes no difference whether the series field goes into the positive or negative side, the only precaution necessary being to see that if you are not running more than one machine, that the various series windings are all in the positive or all in the negative leads, otherwise there will be a short-circuit when you close the equalizer switches.

The Colonial Cement Company, of Wiarton, have just taken tenders on the installation of the necessary electrical apparatus.

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CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

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British Practice. A recent number of the Journal of the Institute of Electricla Engineers (England) contains the report of a paper and discussion on the subject of direct current motor rheostats, or starting switches as they are referred to in the article. The matter is very interesting, as showing the difference between British practice and that obtaining among us. In the first place, in addition to the absorption, or sand and porcelain embedded type, and the direct radiation or open spiral form, they have a third class, namely, that using a liquid, such as soda and water, for the resistance material. This type is practically unknown over here, except for experimental work. A point brought up was that motors of forty or fifty horse-power were considered large, and that probably either a teaser system or a double commutator machine would have to be put in to reduce the starting current. On this continent, neither these nor machines several times their size are found to be beyond the capabilities of an enlarged form of the controlling apparatus used with what we consider very moderate sized equipments. There were many advocates for totally enclosed and also for water-proof construction, forms seldom encountered here unless in outdoor or naval work. There seemed to be a difference of opinion as to the most desirable field connections, some advocating the gradual building up of the field as current was supplied to the armature, this in order to avoid shock or strain to the machine, others maintaining that it was preferable to energize the field before closing the armature circuit, this so as to reduce the starting current. One type provided an indicating lamp as a standard part of the equipment, this acting as a discharge resistance to take the inductive kick of the fields when the motor was shut down, and also as an indicator to show the speed increase of the motor as it was being started, the connections being such that the lamp received a gradually decreasing voltage as the motor speed increased. The aim and object of all our designs is to do away with everything not absolutely necessary; to that end our standard motors are quite able to withstand field kicks, nor do they need speed indicating devices when starting up. As another example of the refinements so frequently found in British products, might be cited the advocacy of a coarse pitched screw, to actuate the contact brush, giving it a slow and steady movement, also the attaching of a centrifugal governor to these parts, so that when the apparatus opened automatically it might do so without shock to the parts concerned. On the whole it would seem as if the practice over there were hedged about and hampered with safeguards and other etcetras, which to our view are totally unnecessary, though if we viewed them from the other standpoint we might find some at least not entirely unjustifiable. On the other hand, it is quite possible to make an article too good, and to surround it with too many safeguards, an appreciation of which fact may be in part the explanation of the tremendous growth of the electrical industry on this Continent.

High Speed Railroading. It will be remembered by most of our readers that some two years ago a most elaborate system of experiments was started, under the patronage of the German Government, with the object of attaining, if it were possible, a speed of 125 miles per hour, or more, from an electrically driven vehicle. The road selected as the scene of the trials was a line running from Berlin to Zossen, and as this formed part of the far-famed German military system, it is reasonable to suppose that it was of superior construction and in good condition. Notwithstanding this, and that the experiments were carried out under the direction of the most distinguished engineers in the country, in collaboration with some of the military staff, the desired speeds were not reached owing to the failure of the track. At 80 to 90 miles per hour this began to show serious weakness, and the trials had to be stopped completely at a rate something under 100 miles per hour. The data observed, however, were most valuable and were such as to justify the prediction that the cars and trucks, with the motors and controlling devices, were capable, in the main, of fulfilling the calculations. In view of this, steps were at once taken to make the roadbed equal to the demands which would be made upon it by the speeds ultimately to be attained. To this end it was considered necessary to completely renew the line throughout and to provide the precaution of two additional guide or guard rails, one on the inside of each of the two track rails. This being somewhat beyond the financial abilities of the syndicate which had originated the tests, the government very properly undertook the work. The changes required considerable time, so that it was only during the past month that they were completed, and the tests resumed.

Commencing at about 90 miles, the rate was gradually increased until a speed of 117 miles per hour was reached. The tests then had to be discontinued, as the line was needed for some days by the military authorities, but upon their resumption the results were even more satisfactory, the enormous rate of slightly over 124 miles per hour being attained, and thus to Germany belongs the credit of the fastest moving human device so far produced, projectiles alone excepted. There are no very definite details to hand as yet, but the cable despatches apparently indicate that the car making the above runs was equipped with 13,000 volt three phase induction motors, built by Siemens & Halske. In the meantime it is interesting to note the main outline of the car with which the first trials were performed. This was equipped by the Allgemeine Elektricitats-Gesellschaft with 4 motors of a nominal aggregate rating of 1100 h.p. and a maximum of 3000 h. p. It was not considered desirable to wind these for a high potential and consequently they were made for 435 volts. They are of the direct connected type, with hollow shafts and special spring couplings, several designs of which were submitted and tested before a final selection was made. It was at first thought that some forced system of lubrication would be necessary, owing to the extremely high bearing speeds, but this introduced great complications in the shape of flexible joints in the piping, and was finally abandoned for the ordinary rinsing system, with disc oilers, which proved quite satisfactory. The transformers were carried on the car, and cooled by an air blast generated by the motion of the vehicle .The trolley line was a three phase 50 cycle system, operating at about 13,000 volts, the three wires being arranged in a vertical plane. The car was supplied with two trolleys per phase, as a precautionary measure, making six in all. They are of the bow type, with sliding contacts, set vertically, and made of aluminum, presumably to reduce the inertia of the moving parts. Many experiments were made to find a controlling device capable of handling 3,000 h.p., a problem never attacked before, and these finally resulted in the selection of the method whereby an external resistance is inserted into the secondary of the motor, a liquid being used as the conducting medium.

Up to this point the system presented no new features, but here was introduced, as a remedy for boiling and as a means of reducing weight, the extremely novel device of keeping the electrolyte constantly in motion, by a small pump, through a set of cooling coils. Further, this added greatly to the ease of control, as it was then a simple matter to vary the resistance, not by the ordinary method of raising or lowering cumbersome and heavy electrodes, but by varying the height of the liquid surrounding them. A small valve accomplished this, sending the circulation into the resistance chamber or through a by-pass at will. In view of the high speeds to be used, it was considered desirable to provide reserve braking equipments, and so, in addition to a Westinghouse air system and hand brake mechanism, provision was also made for reversing the motors very gradually, and further for exciting the fields from a storage battery, the armatures being closed through a resistance. The trucks, two in number, were finally made of the six wheel type, though as at first designed they were to be of the eight wheeled form. Various trials were made on a dummy platform which allowed the wheels to revolve while the car stood still, the motors being brought up to a speed equivalent to a car rate of 125 miles per hour. This served as some sort of a guide as to the suitability of the bearings and the strength of the materials, though many other stand trials had been made of the different parts during design and construction. It will thus be seen that the matter called for the most minute and careful investigation into many problems involving bearing speeds, centrifugal forces, wind resistances, etcetra, hitherto untouched. All these had to be overcome with the least possible material, the reduction of weight being essential, and our German friends are consequently much to be congratulated on the gratifying results which they have obtained.

Since the above was written cable despatches tell of later trials which have resulted in the still more astonishing rate of 131½ miles per hour, coupled with the statement that it was expected that even higher speeds would be attained before the trials come to an end.

ENGINEERING STUDENTS VISIT PETERBOROUGH.

The students of the School of Practical Science, Toronto, in charge of Prof. C.H.C. Wright and Prof. T.R. Rosebrugh, with President Loudon, of Toronto University, and members of the Faculty, visited Peterborough on October 24th on their annual excursion. The many important electrical and engineering works in and around Peterborough were inspected with a great deal of interest and pleasure. The hydraulic lift lock on the Trent Valley canal, which is said to be the largest of its kind in the world, was a revelation to many of the students. The electrical plants of the Otonabee Power Company and the American Cereal Company, the latter being in process of construction, were visited, also the great manufacturing establishments of the Canadian General Electric Company and the William Hamilton Manufacturing Company. In the evening a dinner was held in the Oriental Hotel, with Principal Galbraith presiding.

FIRST AIDS AND APPLIANCES.[*]

By J. D. M'Gowan, M.D.

I believe this is the first time in the history of this association that any paper pertaining to relief of the injured has been read at its meetings ; and it is one of the gratifying signs of the times that the interests of others than the members of the medical profession are being awakened, not only to measures for the prevention of disease, but also for preventing, so far as it is possible to do so, some of the unfortunate results of either improper treatment or no treatment at all in cases of accident, whether of a serious or an apparently trifling character.

Owing to the prompt application of first dressings, in the late war between the United States and Spain, the records of the surgical department of the army and navy show a smaller percentage of loss of life or limb than in any previous campaign.

As all, or nearly all, of your shops are in large cities and towns where the services of a surgeon can be readily obtained, and no great amount of time need elapse from the moment of accident to the obtaining of skilled surgical aid, I will not go into an elaborate detail of all that should be done, as it is far better to do too little than too much.

If your shop is in Pennsylvania, you may have in your employ a young man who has a brother practising medicine in Iowa, and such relationship is apt to make him believe he has the medical instinct which gives him a knowledge superior to his fellows. If you have such a man about, and an accident happens, send him for a doctor.

It is well to have on hand at all shops or factories a box containing the necessary articles for the application of first aid and have a few of your intelligent foremen instructed in their use.

When an accident happens :

Do not get excited.

Send for a surgeon ; tell him briefly the nature of the injury.

Remove the injured man to a quiet, well-ventilated place, neither hot nor cold, away from the noise of the engine room and machinery, and place him in as comfortable a position as possible; lay him upon his back, with his head on a level with his body, and his limbs in a natural position.

Allow nobody near except those who are needed to care for him.

Do not let him know that his condition is serious; encourage him all you can.

If the head has been injured, it should be raised somewhat higher than the rest of the body.

Loosen his clothing at neck and waist ; if patient faints, lower his head and raise his feet.

If arm or leg is injured, it may be slightly raised and laid on a cushion ; a cushion may be made with old clothing or any soft material.

If he vomits, or tries to do so, turn his body on one side, with the chin low, so that the contents of the stomach may flow from the mouth.

If the wound is found covered by clothing, cut the clothing in the seam and remove only enough to show the wound. In case of burns, pour luke warm water over the clothing before attempting to remove it ; otherwise you are liable to pull off the charred skin and leave a large, raw surface open for infection. Cover all wounds and burns as quickly as possible.

In examining a wound wrap some antiseptic gauze around the fingers before touching it. Do not attempt to cleanse a wound ; expose it and apply some antiseptic gauze, or the contents of this little package, called "first help for wounds," and wait for the surgeon to cleanse the parts.

BLEEDING.

From the arteries, blood is bright red and comes in spurts or jets, as from a small hose. This should be immediately stopped if possible, and the best method is to apply pressure over the artery at some point nearer the heart than the point of bleeding, selecting a place where the artery is near the surface of the body. First, apply several thicknesses of gauze over the wound (having fingers wrapped in a separate piece of gauze before handling), and bind tight with roller bandage; then cover the point selected between the wound and the heart, apply pressure, using anything at hand for the purpose—a piece of rubber tubing, such as is used for gas piping, is best, a pair of suspenders, a rope or bandage; bind the parts tightly and leave them until the aid of a surgeon can be obtained.

From the veins, blood is of dark-red color and flows out or wells up freely from the wound. Apply pressure directly over wound, using wad of gauze and bandage.

When the blood oozes from the wound, apply gauze and bandage.

In case of bleeding, keep the patient in a horizontal position; if bleeding from a limb, elevate the limb; keep the patient warm. When bleeding has ceased, hot drinks may be given.

Do not leave tight bandage on a limb too long; the bandage may be loosened after fifteen minutes and reapplied with diminished pressure. In rupture of varicose veins, elevate the limb, loosen clothing, and bandage firmly below the wound, and apply a compress over the bleeding vein.

When a man faints from loss of blood, lower the head and raise the limbs ; be ready to apply compress, if bleeding starts up again.

Do not cover a wound with any dressing that is not sterilized.

Do not forget to elevate the limb.

Do not put on cobwebs, tobacco, shellac or salve.

Do not disturb blood clots.

Do not give whisky or brandy.

Do not leave a wound uncovered after the bleeding has stopped.

For internal bleeding, apply ice-cold cloths to abdomen ; lower the head slightly.

WOUNDS.

In injuries to the head, place the patient on his back, with the head resting upon a cushion covered with a clean towel.

The arm, when injured, should be brought across in front of the chest and supported by a sling.

The lower limb should be supported on a cushion or blanket.

In chest wounds, the head and shoulders should be raised by one or more pillows until patient can breathe comfortably.

In wounds of abdomen, patient should lie down with knees drawn up towards injured side ; if wound be in front, place him on his back.

After covering a wound of any kind, do not uncover it ; put on more bandages if it bleeds.

In bruises or sprains, apply hot water, as hot as can be borne; if an ankle is sprained or foot crushed, place it in a bucket of hot water, keeping the water hot by adding more hot water as required.

FRACTURES.

These may be simple or compound. A compound fracture is where there is an external wound communicating with the fracture. This may be caused by one end of the fracture bone penetrating through the skin, or by a spike or rifle ball or some other missle piercing the skin and tissues to seat the fracture.

Place the patient in a comfortable position, supporting the injured member upon a cushion of some kind, which may be made with any soft material at hand. If possible to remove the clothing without causing much pain, it is best to do so. In simple fractures this is not absolutely necessary, as a splint can be applied over the clothing, using the latter for a pad.

In compound fractures, dress the wound with the contents of the first-aid packets, or with antiseptic gauze, before applying splints.

Do not attempt to set the bone ; merely try to put the injured part in a position where it can be held securely, so as to prevent the fractured ends of the bone from rubbing together and causing pain.

SPLINTS.

The chest can be used as a splint for the arm by binding the arm to the side with a roller bandage.

The uninjured leg may be used as a splint for the injured one.

A splint must be long enough to keep the joints above and below the injury at rest.

The splint should be a little wider than the thickness of the limb.

The splint should be padded with some soft material, such as sheet wadding, cotton, etc.

If two splints, one on each side of the limb, can be applied, all the better.

Material for splints is usually easy to obtain : cigar boxes, pasteboard, laths, shingles, barrel staves, broom handles, canes, shovels, umbrellas, desk rulers, fruit baskets, etc. Any of these may be used.

Place the splint on either side of the injured limb, have the splints well padded and secure them to the limb with a roller bandage or a handkerchief; towels, suspenders, cord or straps may be used if the bandages are not at hand.

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[*] Presented before the National Electric Light Association at its Twenty-Sixth Convention, held at Chicago, Ill., May 26-28, 1903.

Some one should support the limb by slipping the hands gently under it, above and below the injury, while the others are applying the splints.

In fractures of the skull, place patient on his back with head and shoulders slightly raised, and keep quiet until the surgeon arrives. If there is a scalp wound, place some antiseptic gauze over the wound.

In fractures of spine, keep patient flat on his back.

In fractures of collar bone, place pad under armpit and bandage arm to side. Patient is best on his back.

In fracture of ribs, patient should be moved as little as possible. Keep head and chest elevated ; let him lie on his back or on the uninjured side.

In fracture of thigh, apply a long splint made of board, to extend from below the foot to above the hip, first drawing the limb out to its full length, and bandaging the splint to the leg at the ankle, the knee and about the waist.

In fracture of knee-pan, place a pad in the hollow under the knee and apply a splint to the back of the leg, keeping the leg straight.

In fracture of leg below the knee, place the leg gently in a pillow and bind the pillow to the leg. If no pillow is at hand, apply a board splint (taken from a fruit basket) to either side of leg and bandage, being careful not to bandage too tightly.

If a patient is to be carried some distance, bind the injured leg to the other limb, after applying splints.

In fracture of upper arm, place a pad in the armpit and draw the elbow to the side ; bind the upper arm to the side of the chest and put the forearm in a sling.

In fracture of forearm, make a splint from a cigar box, or a piece of wood long enough to extend from the fingers to near the elbow ; place this on inner side of arm and another piece over the back of arm, and bandage.

In fracture of fingers, bind one finger to the other,after placing cardboard splint under the fractured member.

BURNS.

Burns are of three degrees :

First—Simple reddening of the skin.

Second—When blisters form.

Third—Charring of skin and ulceration.

Remove clothing carefully; cover burned surface quickly to exclude air; pour on oil. A mixture of equal parts of linseed oil and lime water forms the best and most convenient dressing for first aid, and should be kept on hand, in well-corked bottles in every shop where a workman is liable to be burned. Pour this freely on the surface, apply sterilized gauze and saturate that, then a layer of absorbent cotton, and soak that with the oil. When the burn covers a large surface, expose and dress a small area at a time. When a man's clothing is on fire, throw him down and roll him over to extinguish the flame, or wrap him in a blanket, or some woolen material, and press the burning points from the outside.

If no oil is at hand use a warm solution of baking soda in water; or use white of egg, or powdered starch, or toilet powder.

When a burn is very extensive, and patient is in a state of shock and grave danger, if there is a bathtub available, wrap him in a sheet, clothes and all, and lower him into the bathtub, which should be filled with tepid water. He may be kept there many hours with his head above the water. This is the best method to relieve pain and to prevent the danger from shock.

Burns from ammonia, lye, etc., should be bathed freely with water, then with vinegar, and then with oil.

Burns from vitriol or other acids should be washed with water, then a solution of soda and lime water, mortar or chalk may be used ; afterwards apply the oil.

A fragment of lime in the eye should be washed out with water, and the eye bathed with a weak solution of vinegar or lemon juice.

TRANSPORTATION OF WOUNDED.

The four-handed seat is made by two persons clasping each other's wrists. Doubtless many of you have done this in your boyhood days at school.

After the hands are clasped together, the bearers stoop down behind the patient, who sits on the hands, and places one arm around the neck of each bearer.

The two-handed seat is made by two bearers clasping their hands and placing their free hands on each other's shoulders. A bearer stands on each side of the patient and passes one arm under his knees and clasps the hand of the other bearer ; the bearers then pass their arms around the back of the patient and grasp each other's shoulders.

The "pick-a-back" method may also be sometimes used. A temporary stretcher may be made by turning the sleeves of a coat inside out ; two stout poles are then passed through them and the coat is buttoned. The patient sits on this and rests against the back of the first bearer. To make a longer stretcher, treat two coats in the same way.

Two sacks may be taken ; a hole is made in each corner of the bottom, and two poles are passed through the sack and out of the holes.

A broad board or shutter may be used as a stretcher ; if used, some hay, straw, or clothing should be placed on it, and then a piece of stout cloth or sacking; the sacking is useful in taking the patient off the stretcher. Always test the stretcher before using.

Never allow stretchers to be carried on the bearers' shoulders.

Always carry patient's feet foremost, except when going up hill.

The "first-aid package," or "accident case," contains many things that are invaluable to the layman in applying relief to the injured ; there are also some articles contained therein which none but a surgeon should be permitted to touch, such as needles, sutures, etc.

If, however, the surgeon, hastily summoned, should have ommitted to bring with him all the requisites for cleansing, suturing and dressing a wound, it would be very gratifying to him to find everything ready for him in such a convenient, compact form.

One of the Chicago Edison emergency boxes, the product of Mr. W. L. Abbott's ingenious brain, is carried on each wagon.

It contains a box of Edison ointment, of whose healing properties we are justly proud, a gauze bandage, a first-aid package, a hypodermic syringe, and a solution containing one-twentieth of a grain of strychnine to each barrel of syringe. The strychnine is to be used to inject under the skin of a man who receives a shock from the high-tension wires. If a doctor is near by, it is well to have the solution ready for him ; in the absence of a doctor the foreman is instructed how to use the syringe.

SHOCK.

Shock is common after serious accident, injury, burn, or from the electric current.

The symptoms or signs of shock are cool, clammy skin, vomiting and retching, weak, rapid pulse, sighing or irregular breathing, half-opened eyelids, dilate pupils, dullness of intellect, and sometimes insensibility.

Place the patient in a warm, quiet place ; after dressing wounds, wrap him in warm material and apply heat to the whole body, using hot-water bottles, water-bags, hot bricks, blankets, flannels wrung out of hot water (no heat to head), hot drinks (coffee best), spirits of ammonia diluted with water or small amount of whiskey.

Electric Shocks.—Susceptibility to shock depends upon the individual; women and children being less resistant than men. Diseases of heart and kidneys predispose to accident from electric shock. Do not lower the head of a person who has received electric shock. Artificial respiration should be kept up for hours. Massage of abdomen and left side over the heart. Heat the body as above.

Remove patient to a room in some adjacent house ; remove most of his clothing ; apply hot water bottles to body and limbs, wrap feet in hot wet cloths. Apply artificial respiration as explained below. Do not get discouraged if the patient does not show signs of life ; keep up the work for several hours. Men have been brought back to life after 10 hours of hard work, so work on patiently and constantly and you may bring back a fellow workman who is apparently dead.

Artificial respiration is produced as follows, whenever it is required : Face upwards; the hard roll of clothing beneath thorax, with shoulders slightly declining over it ; head and neck bent back to the utmost. Hands on top of head (one twist of handkerchief around the crossed wrists will keep them there) ; rip or strip clothing from waist and neck ; kneel astride patient's hips ; place your hands upon his chest, so that the ball of each thumb and little finger rests upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid cartilage, the fingers fitting into the corresponding intercostal spaces ; fix your elbows firmly, making them one with your sides and hips ; then—

Pressing upwards and inwards towards the diaphragm, use your knees as a piviot, and throw your weight slowly forward two or three seconds until your face almost touches that of the patient, ending with a sharp push which helps to jerk you back to your erect kneeling position. Rest three seconds ; then repeat this bellows-blowing movement as before, continuing at a rate of from seven to ten times a minute; taking the utmost care, on the occurrence of a natural gasp, gently to aid and deepen it into a longer breath, until respiration becomes natural. When practical, have the tongue held firmly out of one corner of the mouth with thum and finger armed with a dry cotton rag. Avoid impatient vertical pushes ; the force must be upward and inward, increased gradually from zero to the maximum as the age, sex, etc., may indicate. Abandon no case as hopeless within an hour's useless effort.

The following methods may be employed : (1) Lay the patient on his back, with the shoulders elevated, draw the tongue forcibly forward, grasp the arms at the elbow and carry them upwards firmly until they nearly meet above his head, then lower them to the side, and make firm compression upon the lower part of the breast bone ; repeat this process 12 to 14 times in the minute. Or (2) turn the body gently and completely, on the side, and a little beyond, and then on the face, alternately ; repeating these measures deliberately, efficiently and perseveringly 15 times in a minute.

TELEGRAPH and TELEPHONE

NEW MANAGER OF THE G. N. W. TELEGRAPH COMPANY.

Mr. Isaac McMichael, who has succeeded Mr. H. P. Dwight as general manager of the Great North-Western Telegraph Company, was born at Brantford, Ont. At the age of sixteen years he learned telegraphy, and served four years as operator with the Montreal Telegraph Company and the Buffalo & Lake Huron Railroad Company. Recognizing the greater possibilities in the United States, he went to Ohio in July, 1860, and entered the service of the Western Union Telegraph Company as an operator. Fourteen months later Mr. McMichael went to St. Louis and entered the military telegraph service of the United States Government. He remained in that service in Missouri, Kansas, Arkansas and Indian Territory until May, 1865, when he returned to St. Louis and re-entered the service of the Western Union Telegraph Company service as operator.

Mr. Isaac McMichael,
General Manager of the G. N. W. Telegraph Company.

In 1868 Mr. McMichael was appointed as chief clerk at St. Louis, and in 1868 as chief clerk to Mr. R. C. Clowry, District Superintendent. His executive ability was further recognized in 1875 by his appointment as asssistant superintendent at St. Louis, and in July, 1881, as superintendent of the Eighth District, Western Division, at Minneapolis, in charge of the telegraph lines in the North-West which were acquired at that time by the Western Union Telegraph Company from the North-Western Telegraph Company. This position he retained up to October 31st of this year, when he assumed his dutes as manager of the G. N. W. Telegraph Company, with headquarters at Toronto.

In 1881 the territory under Mr. McMichael's charge comprised 9,076 miles of poles, 21,482 miles of wire, and 1,019 offices. During the period from that time to the present it has grown to 21,785 miles of poles, 96,070 miles of wire, and 2,533 offices. Under his jurisdiction the company's lines were extended to the Pacific Coast over the Northern Pacific Railroad in 1883 and over the Great Northern Railroad in 1893.

In Mr. McMichael the G. N. W. Telegraph Company have doubtless secured an efficient executive officer, and Canadians generally will welcome his return to this country.

GLASGOW MUNICIPAL TELEPHONE SERVICE.

Two years ago Turnbridge Wells and Glasgow were pointed to as bright examples in municipal ownership of telephone service. A few months ago the former abandoned the attempt at giving a satisfactory telephone service and sold their plant to the National Company. Now reports are coming to hand ot unsatisfactory results in Glasgow. "The Bailie," a journal published in Glasgow, in its issue of September 9th, says:

"The position of the Glasgow Corporation Telephone Department as disclosed by the published accounts for the past financial year, is proving a source of uneasiness to those ratepayers with a sound knowledge of finance. Nor have their fears been alleviated by the auditors' remarks, who, in issuing their report, make it perfectly plain that things are not as they ought to be. They point out that no depreciation has yet been provided for, nor has any sum standing at the debit ot preliminary and general expenses in capital account been written off out of revenue. In the matter of the sinking fund adequate provision has not been made, although, according to the auditors, the requirements of the Act of Parliament have apparently been complied with. Up till now, certain management expenses, amounting in the aggregate to no small sum, have not formed a charge against revenue. Despite all this the committee who run the telephone department have the temerity to present the ratepayers with a financial statement showing a balance of several thousand pounds on the right side, and claiming that if the undertaking had been a joint stock enterprise the result would have been that a dividend of five per cent. on the capital involved would have been paid. In this connection let it be pointed out that had the directors of a concern formed under the Companies Act put forward a balance sheet such as the one under review, and declared a dividend, they would have laid themselves open to much the same charges as are confronting at present Mr. Whittaker Wright, of London and Globe Finance Company fame, in which undertaking the trusting shareholders lost all they had risked.

"It is greatly to be feared that instead of getting out of the tangle the telephone department will land itself deeper into the mire, although this is a contingency apparently viewed with equanimity by those in control, who, of course, have nothing to lose. It has been said that figures can be made to prove anything, and if there is one thing the balance sheet of the corporation telephone shows, it is that the ratepayers of Glasgow have been saddled with a white elephant as matters stand at present. Were the enterprise a successs apart from its financial aspect, there mignt be some hope, but unfortunately the service is falling far short of what it ought to be, having regard to its formation at a period when the telephone business has been pretty well reduced to a fine art."

Napoleon Chamberlain, 48 years of age, a lineman in the employ of the Bell Telephone Company, died in Notre Dame Hospital, Montreal, last month, from the effect of injuries received by falling from a telephone pole at the corner of Harbor and St. Catharine streets.

ENGINEERING and MECHANICS

STEAM BOILER INSPECTION IN BRITISH COLUMBIA.

About four years ago the British Columbia Government passed an Act entitled "The Steam Boilers' Inspection Act," which provided that all steam boilers should be regularly inspected by official inspectors and that engineers operating same should first pass an examination as to qualification. In accordance with the provisions of the Act, Mr. John Peck, of New Westminster, was appointed chief inspector of boilers and machinery, and has as assistants three district inspectors, Messrs. Thomas H. Goldie, S. Baxter, and George O. Madigan.

Mr. Peck has just issued his first annual report, which covers the calendar year of 1902. This report shows the vast amount of work that has been done under the inspection service, and clearly demonstrates the wisdom of compulsory inspection of boilers.

All candidates for engineers' certificates are thoroughly tested as to their knowledge of the safety valve, water gauge, steam gauge, appliances for feeding water to the boiler, the method of keeping boilers free from corrosion and incrustation, and also as to their knowledge of adjusting the principal parts of simple engines in cases of necessity. In addition to the above requirements, candidates for first and second-class certificates are given some questions in respect to compound engines, air compressors, and other machines usually found in a large steam plant.

During the year 1902 the chief inspector received 566 applications for engineers' certificates; 359 candidates were examined; 203 applications are still on file, and 4 applicants had their fees returned, as they had not the practical qualifications required by the Act.

Part of the chief inspectors' report is printed below:

We have on our report books records of 1,229 boilers that have been inspected at some time during the last 3½ years. We have also located 470 boilers which have not yet been inspected, although the owners of a great number of these have applied for inspection. The number of complete inspections during the past year was 860, leaving 839 on which no inspection was made. 321 new boilers were inspected during last year and put into operation and 57 were taken out of service. I have reason to believe that the boilers to be installed during 1903 will be very much in excess of last year's record. If last year's figures are taken as a basis, we may estimate that there will be 1963 boilers to inspect during 1903; and if we take the 860 boilers inspected last year as an estimate of the work that can be attended to by the present staff, it will be seen that there must be a substantial increase in help, if anything like the whole of the work is to be accomplished.

I beg to direct attention to the items of inspecting and testing material for new boilers. This has resulted in condemning nearly 10% of the plates inspected. As the cost of replacing these plates usually falls on the supply houses, they are now more careful regarding quality of steel sent to British Columbia customers. Too much care cannot be exercised regarding the physical and chemical properties of the steel to be used in boiler construction. Acid and Basic Bessemer Steel is quite unfit for boilers, and so is Basic Siemens-Martin Steel if made of phosphoric pig; the latter, however, if made of good pig, is satisfactory.

Experience has shown that the cold tests of sheered plates and temper-bending tests will show up bad plates, and as these tests are simple and require no appliances, we are able to carry them out. With respect to tensile strength, elongations and reduction of area, we are obliged to rely on the steel maker's reports.

It will be noticed that 332 boilers have been repaired under the Inspector's directions. These necessitated 95 special inspections after repairs were executed, and 656 additional visits.

There have been 21 accidents to engines and boilers. The engine accidents are reported under District Inspectors' reports. The boiler accidents were the result of low water, and of burning of the plates, due to excessive scale and sediment being allowed to collect on the fire sheets. It is pleasing to note that there have been only two accidents resulting in personal injury; these are reported fully in the District Inspectors' reports.

The defects observed were 2,102, of which 156 were dangerous; this is the most serious item in the report; and I hope that as the engineers realize more and more their responsibility for a number of these defects, and strive to prevent boilers being operated at a higher pressure than is consistent with safety, that these defects will be materially reduced in future.

The summary of total defects gives a very clear idea of a part of the work which is considered most important, as it is owing to the discovery and proper repair of these defects that accidents more or less serious are prevented, the life of the plant lengthened, the cost of repairs reduced to a minimum, and the plant kept steadily in operation, instead of being suddenly shut down many times during the year to repair different defects which make themselves known by serious leakage.

I may be permitted to explain that the examinations by our inspectors are the most thorough that is possible. The boilers are emptied and cleaned inside and out, and the inspector, with his testing hammer, goes over every accessible part inside the boiler, inside the furnaces, and in cases of brick-set boilers, through all flues, and finally examines the external part of the boiler and its fittings. In this way most of the defects enumerated were found.

When boilers are being inspected for the first time, careful measurements of all parts are taken, the attachments of stays and braces are carefully noted, and sketches are made of the interior construction. The strength of each part is calculated and the maximum working pressure fixed. The boiler is then filled with water for the hydrostatic test, which is applied to one and one-half times the calculated working pressure. Contrary to the opinion of the general public, the hydrostatic test is of little value unless conducted by an expert, and is a source of danger if applied by persons who do not understand the physical properties of the material which is being tested. There is a very general idea that if a boiler is tested to 150 lbs. and does not show serious leakage, it is perfectly safe for 100 lbs. steam pressure. While this boiler did not burst, nor the stays break, during the above test, it does not follow that some of the material may not have been permanently injured, and to such an extent that when steam pressure at 100 lbs. has been acting upon it for a short time the boiler may explode.

The press reports many boiler explosions which occur only a few days after the boilers have been tested by water pressure, and sometimes mention that in order to make sure the boilers were safe, twice the working pressure was applied during the test; and these are referred to as "mysterious explosions." The only persons to whom boiler explosions are mysterious are those who do not understand the subject. Under certain conditions, boilers will explode as surely as the force of gravity attracts a mass of matter. Both obey natural laws, and if the boiler explodes it is because the forces acting upon the material composing the structure are in excess of its strength. It is only necessary, therefore, to know the strength of the material, and the direction and magnitude of the forces acting upon it.

The force generally considered is that of the steam pressure and the strength of the material, its ultimate breaking strength; and it is on account of the consideration of these conditions only that many defects develop and many accidents occur. In addition to the force due to steam pressure, there are the forces which arise from the sudden or unequal expansions and contractions of the different parts of the structure; the stresses due to the weight of the boiler upon its supports; the stresses due to flanging and forming of the different parts during construction; the unequal distribution of stresses at rivet joints; and the extra stresses due to plasticity of the structure. Instead of the strength of the structure being taken as the ultimate breaking strength of the material, it must be taken as the elastic limit of the material, which from a great many carefully conducted tests, by various authorities, is assumed to be two-fifths of the ultimate breaking strength; when the elastic limit of material is reached, any further addition to the load produces permanent set. If this takes place in the stays, they become permanently elongated, and when pressure below that which produces permanent set acts on the structure, the flat parts, which were supposed to be held by these stays, are free to move; add this continued movement results in crystallization of the sheets, and sooner or later, in the fracture of these at the hinging point.

Take a boiler tested by a person who does not realize the importance of considering the elastic limit of the material. Allow a factor of safety of "4," and assume that the safe working pressure is 80 lbs. The owner thinks it is safe for 100 lbs., and has the hydrostatic test applied for 150 lbs. per square inch. The ultimate strength of the material would be reached when the hydrostatic pressure was 320 lbs., and it is not likely that the boiler would burst until that pressure had been reached, if it was applied gradually and carefully by pumping up. The elastic limit is two-fifths of the ultimate breaking strength, and this limit would be reached when the test pressure was up to 126 lbs., and from that on to 150 lbs. the material would stretch at the weakest part.

When the steam pressure is applied at 100 lbs., or even at 80 lbs., the parts of the boiler which originally resisted the alteration of shape have been elongated and are now of little value; the strains which should have been taken by these parts are thrown on to others, resulting in crystallization, and, sooner or later, in rupture of the parts on which this extra strain is thrown.

It will be seen from the above that if the hydrostatic test is to be of any value, calculations must first be made, and the test pressure must never exceed, or even approach very close to, the elastic limit; and during the test the different parts of the boiler must be carefully gauged and measured to see that there is no alteration in the shape of the structure.

With respect to the defects enumerated in the attached summary, I wish to call attention to some of the more important. It will be seen that safety valves have not received the consideration from many steam users and engineers that one would think the merest novice would bestow on this all-important part of the steam plant. One boiler in District "C" was found without a safety valve of any description; four safety valves were found inoperative, five have been found overloaded, and 69 defective in construction; of which 20 cases in all were considered dangerous. The defects discovered are all in the old ball and lever type of safety valve. These are being replaced by the modern pop safety valve on all boilers where alterations to safety arrangements have to be made, and only the latter type are allowed on new boilers. In this way I hope to reduce these defects to a minimum.

Under pressure gauges, 158 defective is a large item, but not so dangerous as the defects mentioned above, unless the engineer alters the safety valve to suit the pressure shown by the gauge, when the same indicates less pressure than that actually on the boiler. The fact that 48 gauges were found inoperative (as well as four safety valves) shows that there are still a number of careless engineers.

The next item of insufficient staying or bracing, 84 cases, of which 20 were considered dangerous, calls for some comment. These defects are not confined to any one particular district, but are fairly equally distributed throughout the province, and are, in almost every case, found on cheap boilers, quite a number of which have been purchased from second-hand machinery agents in United States and Eastern Canada before the Inspection Act was enforced. Some few cases have occurred where new boilers have been sent in from the United States, and one such case I will cite as an illustration. A farmer on the Delta ordered a threshing engine from an American firm, to carry 150 lbs. per square inch working pressure. He became suspicious after placing the order, and asked me to have the boiler inspected before it was taken off the car, which was done. The stays were found to be insufficient, and he wired the company to that effect. They replied "Accept engine, will make good." A few weeks ago the company's agent offered the farmer $200 to get the repairs made himself. This was refused, and the deficiency is now being made good by a British Columbia company at the American firm's expense. This is a case where one farmer was saved $200 as a direct result of the working of the Inspection Act. Many other similar cases could be mentioned, but this serves as an illustration of them all, and such cases constitute one of the reasons for the general popularity of the Inspection Act.

A case is also given in the report from District "C" of a new return tubular boiler built in the United States, having four one-inch stays supporting the segment of the head above the tubes at one end, and seven one-inch stays supporting the segment at the other end; the latter even being insufficiently stayed. This means that the four stays would be carrying a load of about 46 tons if the boiler had been worked at 100 lbs. per square inch. I am inclined to think that if 46 tons were suspended over a sidewalk by four one-inch rods, there would be a tendency in most people to walk in the street instead of passing below the weight; and yet these same people would feel perfectly safe near this boiler head, simply because they would not realize the danger in the same way as they would if they actually saw the weight suspended.

Under defective riveting I wish to call attention to a case discovered in district "A," particulars of which are given in the report from that District. This is the second case of the same nature that has been found in this District. Both boilers were built by the B.C. Iron Works, Vancouver, and the company had failed before either of the defects were discovered, so that no action against them could be taken. Men who will do such work, as well as men who will allow such work to be done, should be dealt with to the fullest extent of the law. It is fortunate that in both these cases the boilers had only been operated for a short time at a low pressure before the defects were discovered.

Under the heading "Boilers with fractured plates," 43 cases are reported, six of which were dangerous. These cases have occurred mostly from two causes, over-pressure and defective settings. Where lap-joints are used at the longitudinal seams, the part of the shell near the seams is flatter than the remainder of the circle, and when the boilers are subjected to internal pressure, the flat parts of the shell tend to assume part of a circle of the same radius as the shell itself, and a hinging action takes place at the edge of the lap, usually on the inside. It has also been found that in most cases where cracks develop in the centre circumferential seams, the boilers are not properly supported on their settings, the brackets being placed near the ends, thus throwing additional strains on this part of the boiler, due to its weight. As the lower part of a return tubular boiler is subjected to severe strains due to difference of temperature between top and bottom, care should be exercised regarding supports.

"Boilers with burned plates," 73 cases, five of which are dangerous, may be commented upon, for the reasons that these accidents might be altogether prevented by the owners and the engineers. The greatest number of these cases occurred as a result of negligence on the part of the management to have the blow-off pipes removed from back head (where they cannot be placed nearer the bottom of boiler than five or six inches, on account of the curve of the head flange) to the bottom of the shell, as requested by the inspector. The alteration requires a few feet of pipe and a screwed flange riveted to boiler shell. As these are not usually at hand when the inspection is made, the inspector sees that the boiler is properly cleaned out at that time, and leaves this change to be made at the next wash-out. Advantage is sometimes taken of the inspector's leniency, with the result that an alteration which would have cost $5 or $10 and the loss of one day has, in many cases, cost the owners from $150 to $200, with the loss of a week or more. This was reported in detail at the time, and is also mentioned in the inspector's report.

District "C" has been particularly unfortunate in this respect, having 45 cases out of a total of 73, the reason for this being the increased latitude given by the inspector, at the request of the management of the mines or mills, to keep the plants running. In some cases the defects occurred through the engineers not properly cleaning out the boilers when they were opened up for that purpose.

The cases of scale or incrustation, 214, of which 22 were dangerous, should be materially reduced if the engineers and owners of the plants would work together, and see that the boilers get proper attention, as far as cleaning out is concerned.

SUMMARY OF TOTAL WORK DONE IN 1902.

No. of drawings and specifications calculated for new boilers	114
" boiler plates inspected	55
" boiler plates rejected	5
" boilers built under inspection in B.C	64
" boilers built under inspection in Eastern Canada	24
" new boilers inspected	321
" new boilers inspected built in B.C	64
" new boilers not inspected built in Eastern Canada	44
" new boilers inspected built in United States	15
" old boilers inspected built in United States	107
" boilers imported from Eastern Canada (second hand)	1
" old boilers imported from United States (second hand)	1
" boilers unclassified	23

Summary of Total Work Done in 1902 (Continued).

numer of bfirst inspections	546
" inspections, external and internal	810
" internal inspections only	11
" external inspections only	119
" special inspecitons after repairs	95
" visits in addition to inspection	656
" boilers subjected to hydrostatic test	783
" boilers on which pressure was reduced at first inspection	110
" boilers unsafe without extensive repairs	32
" boilers repaired under Inspector's directions	332
" boilers considered unfit for further use	8
" accidents to engines and boilers	21
" accidents resulting in personal injury not fatal	2
" investigations	5
" inspections completed	860
Total horsepower of boilers inspected	35,806
No. of defects observed, as per summary	2,102
" defects considered dangerous	156
Boilers taken out of service	57
Inspection fees earned	$7,281.63
Inspection fees collected	$6,423.23
Miles travelled by inspectors	26,340

NATURE OF DEFECTS.

	Whole No.	Dangerous.
Boilers without safety-valves	1	1
Boilers with safety valves inoperative	4	4
Boilers with safety valves overloaded	5	2
Boilers with safety valves defective in construction	69	16
Boilers without pressure gauges	1	1
Pressure gauges inoperative	44	2
Pressure gauges defective	158	2
Cases of insufficient staying or bracing	84	20
Cases of defective stays	3	
Cases of broken rivets	23	
Cases of defective riveting	38	5
Cases of broken stays or braces	8	
Cases of loose stays or braces	72	5
Boilers damaged by low water	5	3
Defective settings	70	7
Boilers with fractured plates	43	6
Boilers with laminated plates	17	4
Boilers with burned plates	73	5
Boilers with blistered plates	2	
Cases of sediment on fire sheets	44	2
Cases of internal corrosion	78	
Cases of scale or incrustation	214	22
Cases of internal grooving	5	
Cases of external corrosion	96	5
Cases of defective tubes	59	
Cases of defective feed water arrangement	121	
Cases of broken feed valves	1	
Serious leakage around tube ends	18	4
Serious leakage in rivet joints	88	2
Defective blow-off pipes or cocks	148	4
Defective water gauges	48	13
Broken blow-off pipes or cocks	3	3
Water columns without blow-outs	6	3
Cases of broken test cocks	11	
Connections to water columns without valves	7	7
Neutral sheets not stayed	55	
Neutral sheets improperly stayed	69	
Furnaces out of shape	2	
Boilers without fusible plugs	127	
Boilers low at front end	27	
Cases of serious leakage of fittings	40	
No. of hand-hole doors having bolts and dogs burned off	4	4
Leakage at hanger lugs	1	
Cases of battery of boilers having no check valves	1	1
Defects in engine frames (broken frame)	2	
Defects in engine cylinders (broken flanges)	1	1
Boilers without hand-holes	1	
Boilers without stop valves	22	
Cases of defective steam pipes	4	
Unclassified defects	79	2
	2,102	156

MR. JOHN PECK.

Mr. John Peck, Chief Inspector of Boilers and Machinery for British Columbia, was born in the town of Billericay, near London, in 1851, and received his education in public schools. Having a natural aptitude for machinery, he selected mechanical engineering as a profession, serving his apprenticeship with a well-known firm of London engineers. Mr. Peck emigrated to Canada in 1882 and was for a time employed by the C.P.R. in Manitoba. Returning to England in the fall of 1885 to further his technical knowledge at one of the engineering schools, he obtained the position of engineer to the local Government Board for the districts of Wandsworth and Clapham, and entered the Berbeck Institute and City and Guilds of London Institute, undergoing a four years' course of evening classes and taking no less than thirteen first-class certificates in steam and mechanical engineering, electric lighting and transmission of power, mechanical drawing and other branches.

In 1890 Mr. Peck returned to Canada and located in New Westminster where he was employed by the Reid & Currie Iron Works as foreman. When this company ceased business he was appointed liquidator, and on the reorganization of the concern became manager and part owner, eventually purchasing the entire plant and establishing the Vulcan Iron Works, which, until wiped out by fire, was a prosperous institution. In June, 1901, the British Columbia Government appointed Mr. Peck to the office of Inspector of Steam Boilers and Machinery, a position which his technical and practical knowledge enables him to fill in an able and most satisfactory manner. Mr. Peck has been a member of the Board of Trade and City Council of New Westminster, and takes a lively interest in public affairs.

MR. JOHN PECK,
Chief Inspector of Boilers and Machinery for British Columbia.

TORONTO ENGINEERS' DINNER.

Once more on Thanksgiving Eve, October 14th, the Toronto engineers and their friends " feasted " of dainty dishes, speech and song at the Walker House. For the seventeenth time the members of Toronto No. 1 appeared as the dispensers of hospitality, and on this occasion Mr. N. V. Kuhlman, the worthy president, was in the chair. Nothing was lacking in the menu to appease the appetites of the numerous guests, and everything passed off in first-class style. Letters of regret were ready from His Worship the Mayor, Ald. Oliver and City Engineer Rust.

The chairman, after a few words of welcome, asked the party to drink with him the health of the King and the Royal Family, followed by the singing of the National Anthem. Then Mr. Thomas Crawford, M.P.P., responded to the toast of " Ontario, the Banner Province." He pointed out that the banding of engineers together for mutual advancement in educational matters meant a saving of life and property. He was desirous that the engineers should receive more recognition and protection from the Government, and thought much opposition to a compulsory license law came from persons who had wrong impression of the situation. In responding to the toast of " Toronto, the Queen City," Ald. Richardson spoke encouragingly to the engineers, pointing out the important relation which the engineer and the manufacturer bore to the prosperity of the country. Mr. J. Litster, manager of the Pure Gold Manufacturing Company, replied to the toast of " Our Guests," while coupled with the toast of "Our Manufacturers " were the names of Mr. G. R. Baker, of Westman & Baker, and Mr. Thomson, of the Otis Elevator Company. The latter said that the position of the engineer was being improved by the large number of new manufacturing establishments that there were being located in Canada. Nine American firms had recently established factories in Hamilton, and he believed that in other cities more or less advancement in this direction was being made. Mr. A. M. Wickens acknowledged the toast of " Our Manufacturers." He spoke of the responsibility of the engineer's position; he must know all about elevators, plumbing, steam and electric plants, etc. The Technical School in Toronto had done much to start engineers on the right course, but he feared that its usefulness would be impaired by the proposed change of management under which the Technical school, high schools and public schools were to be governed by the same board. Mr. H. E. Terry and Mr. Charles Moseley replied to the toast of "The Executive," "Toronto No. 1" was then toasted and brought a response from the president, Mr. Kuhlman.

Under the direction of Mr. George Grant a splendid program of entertainment was furnished by Messrs. E. Harrington, H. Ruthven McDonald, R. Wilson, E. Crawford, John Alexander and Howard Fletcher. The dinner committee was composed of N. V. Kuhlman, president ; G. C. Mooring, chairman ; W. H. Johnston, secretary-treasurer ; J. G. Bain, Alex. Storer, H. E. Terry, James Bannon, A. J. Butcher, and W. L. Oathwaite.

MR. N. V. KUHLMAN.

The president of Toronto No. 1, Mr. N. V. Kuhlman, is recognized as one of the first engineers of to-day. He has always taken a deep interest in the success of the Canadian Association of Stationary Engineers and his election as president was well deserved. For sixteen years he has been superintendent of the Ontario Power & Flats Company, which supplies power to a number of manufacturing concerns located in their building at the corner of Niagara and Tecumseh streets, and which has a frontage of 240 feet on Tecumseh street and 320 feet on Niagara street. It is a five-storey brick building, with over 150,000 feet of floor space, rented to the following manufacturers: John Gilchrist, sash and door factory and planing mill, employing fifty men; Barthelmes & Company, piano action and piano keys, 125 men ; Spanner & Company, fancy wood turners, 25 men; W. Bohne & Company, piano hammer makers, 12 men ; Hammer Piano Company, manufacturers of pianos, 100 men ; Mason & Risch Piano Company, 100 men; Carlyle Manufacturing Company, furniture, 10 men; Toronto Woodworking Company, rules and variety woodwork, 12 men; United Electric Company, electrical machinery, 75 men; Fairles Milling Company, flour and cranes, 10 men; Toronto File Works, 25 men. The steam plant consists of a pair of Brown twin engines, 350 horse power, built by the Polson Iron Works, and three boilers of the same capacity, while there is now being installed one Heine safety water tube boiler of 300 horse power, which will give them a total of 650 horse power. At present the power is distributed by means of shafting and belting, but it is proposed to install an electric plant and furnish the power through motors. There are also installed in the building two large dry kilns for drying lumber, with a capacity of 150,000 feet. These kilns were designed by Mr. Kuhlman and constructed under his superintendence. They work very satisfactorily, about 50,000 feet of lumber being dried each week.

MR. N. V. KUHLMAN,
President Toronto No. 1. C. A. S. E.

Mr. Kuhlman is deeply interested in society work, being a member of St. John's Lodge A. F. & A. M., Albert Lodge I.O.O.F., Canada Council, Royal Arcanum, and Fidelity Tent K.O.T.M.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS, Imperial Building.

November 4th, 1903.

It is announced that Mr. W. McLea Walbank has accepted the position of first vice-president and chief engineer of the Montreal Light, Heat & Power Company. It is contemplated to give Mr. Walbank very largely the guidance of the practical part of the company's affairs, as to development of business and regulation of expenditure. The company are to be congratulated on securing Mr. Walbank's services, as his past experience should prove of great value to him in his new position. Besides, he is a Montrealer, and very popular.

Recently Mr. G. B. Burland, who was president of the Lachine Rapids Hydraulic & Land Company, entertained his co-directors and the managing director, Mr. Walbank, at dinner at the St. James' Club. The occasion was taken advantage of by the president and directors to make a presentation to Mr. Walbank of a beautiful sterling silver tea service, accompanied by an address expressing the high appreciation which the directors entertained of his services as managing director of the company.

The evening papers devoted some space to informing the public how the double-truck cars were now running on the Windsor circuit, etc. If they had used the word in the singular instead of the plural their remarks would have been nearer the mark However, the sample is appreciated, and it is hoped that this line, which is admitted to be the best paying one, will soon have more put on it and the disgraceful "sardine boxes" now equipping it relegated to the scrap heap, where they belong. By the way, this is the line which takes visitors both from the G. T. R. and C. P. R. stations up to the Windsor Hotel.

The Bell Telephone Company are working hard at their new building on Hospital street, in rear of the present main exchange. Upon completion a "central energy" switchboard will be installed. The magnitude of the work of transferring from one switchboard to the other, and yet keeping subscribers' lines in operation, will be appreciated by those acquainted with telephone data.

The war among manufacturers of electrical fittings goes merrily on. Cut, cut, cut, is the rule in Montreal. Certain articles wholesaled at 13 1-5 cents, and retailed at 13½, and so on all along the line. No protection to trade. Running expenses of the business apparently nil. A reaction with a vengeance to the schedule at reasonable figures adopted by all a year or so ago. The schedule was unique in its way, as the prices were put down low to prevent importation. Now importing is more indulged in.

The delegates to the Commercial Congress from England expressed the hope for a federal bankruptcy law in Canada. The Canadian Manufacturers' Association are agitating the question. Why not the Canadian Electrical Association also, as surely the electrical trade feel the need of such an act as much as other trades.

The annual statement of the Montreal Street Railway for the year ending September 30, 1903, has just been issued. It shows the gross receipts to have been $2,222,000 and the operating expenses $1,316,000, being an increase of $176,000 in gross earnings and $182,000 in operating expenses. The decrease in net earnings is accounted for by the fact that during the year the company had two strikes on its hands. There were carried during the year 54,500,000 passengers, as compared with 49,900,000 in 1902. Transfers issued numbered 16,700,000, as compared with 15,000,000 the previous year. The net earnings were $905,939.01, as compared with $911,032.27 last year. After providing for the percentage on earnings accrued to the city, and interest on bonds and loans, the directors declared four quarterly dividends, amounting to $600,000, and in view of the company having assumed their own fire insurance risk, placed an additional sum of $25,000 to the credit of that fund, which now amounts to $239,377.31, and $50,000 to the credit of the contingent account, leaving a surplus of $9,907.54, which was transferred to the general surplus account of the company. An amount of $54,130.18 expended during the year on special renewals was charged against the contingent account.

VAST ENGINEERING PROJECT.

One of the largest engineering projects in the world is now under consideration by the African Concessions Syndicate. The details of the undertaking will not be settled until the site has been further surveyed, an operation for which the sum of $10,000 has been allocated. The proposition is the utilization of Victoria Falls, in Rhodesia, a far greater scheme than the harnessing of the Niagara Falls. The total height of the Niagara Falls is about 160 feet, whereas at the Victoria Falls the height is more than 400 feet. Again, while the total power running to waste at Niagara is estimated at 7,000,000 h.p., the available power is put at 35,000,000 h.p. As electricity is now recognized as the most economical agency for traction, it is believed that the Rhodesian railways will afford an opening for the supply of large quantities of energy when the proposed works have been established. Various mining centres already established should also be responsible for a very considerable consumption, while the development of the iron, copper and coal industries, together with the concurrent increase of miscellaneous manufacturing industries and the growth of cities and towns, will afford further scope for the absorption of power. If a radius of 600 miles could be served from the proposed power station at Victoria Falls, the whole of the goldfields of South Africa would be included in the area, and a large proportion of its railways. In other words, the area would comprise 1,500,000 square miles, including the whole of Rhodesia, Bechuanaland, and the Transvaal, as well as the greater part of Portuguese Mozambique, German South West Africa, Portuguese West Africa, and the Congo State.

RULES FOR LINE FOREMEN.

In a very instructive paper on "Overhead Pole Line Construction and Operation for Central Stations," read at the recent convention of the Association of Edison Illuminating Companies, the authors, Messrs. A. H. Manwaring and J. T. Hutchings, submited the following general rules to be followed by line foremen :

1. No wire of smaller size than No. 6 B. & S. gauge shall be used for either primary or secondary work.

2. All alternating-current primary line wire shall be erected on porcelain insulators upon adjacent pins.

3. All arc line wire shall be erected on double petticoat glass insulators.

4. Alternating-current and arc line wires shall in no case be placed upon the same cross arm unless the pole is between.

5. All joints shall be well soldered and taped.

6. Secondary lines shall at all points be at least 18 in. from primary or arc lines unless covered with heavy porcelain tubes.

7. Fuse boxes shall be placed upon all branch circuits.

8. The main circuits shall not be fused as long as the wires are maintained of the same size as at the station.

9. Fuse boxes for branch circuits shall in all cases be fused 25 per cent. smaller than the main fuse at switchboard ; and in no case shall branch fuse boxes be fused with copper wire.

10. Fuse boxes for branch circuits shall be placed upon the first pole from the junction pole.

11. Transformers shall not be placed on the exterior of buildings, sheds or other property belonging to the consumer.

12. All poles having transformers or fuse boxes upon them shall be stepped.

13. No fuse box or transformer shall be placed upon a junction pole or lamp pole, except where absolutely necessary, in which case the office shall be notified and permission obtained.

14. Transformer poles shall in all cases have full six-pin arms.

15. In placing transformers for motors, 1 k.w. should be allowed for each horse power up to 30 h.p., except where a number of motors are installed upon one group of transformers, in which case the capacity may be reduced in accordance with the condition of load.

16. All consumers having 200 lights or over, who are not regular in their hours of burning, such as churches, lodge rooms, public halls, etc., shall be placed upon two-phase wherever possible.

17. In connecting two-wire consumers upon three-wire secondary circuits, care should be taken that the load is evenly balanced, as to location and time of burning.

18. Wherever practicable, consumers should be grouped upon one transformer, or system of transformers and secondary wires.

19. The object in grounding a secondary wire of transformers is to prevent high-tension current from reaching the secondary wires. The neutral wire of all three-wire secondary circuits must be grounded, and also one side of all two-wire secondary circuits.

20. It is of the utmost importance that the primary fuses protecting each transformer shall be of a size proportionate to the capacity of the transformer. When a transformer is fused excessively heavy, or with fuses of dissimilar sizes, one fuse only is liable to blow, thus leaving current on the defective transformer.

21. It is essential that, when a primary fuse on the transformer is blown through any cause, the secondaries should be disconnected from the transformer and the latter tested to full line voltage between the primary and secondary coils, so as to determine that there is no breakdown in the insulation between these coils.

22. All alternating-current circuits should be tested daily for grounds.

23. All series lighting circuits should be tested for grounds within ten minutes after the circuits are taken off, and for open circuits, crosses and grounds at 12.10 p.m. and 3.10 p.m., and also one hour before starting time.

SMOKE CONSUMERS.

Dr. A. W. Drysdale, of Philadelphia, recently delivered a brief address on smoke consumers before the Toronto branch of the Canadian Manufacturers' Association. Dr. Drysdale said that the only real smoke consumer was "perfect combustion," which it was impossible to get. He said that a perfectly even fire, which could only be obtained by having a thoroughly good stoker, was one of the best smoke consumers known. It was impossible to prevent smoke when forcing or cleaning a fire. Ocean steamers did away with a great deal of smoke by a process of condensing. The best method for a stoker to pursue was, when firing, to feed in front, use coke, and keep the fire renewed from the front. He said it was impossible to start a furnace without smoke, no matter what the device.

On Thanksgiving Eve the premises of the Dominion Motor & Machine Company, 231 King street east, Toronto, were damaged by fire, several automobiles being destroyed.

THE COST OF STEAM POWER PER ANNUM.

There is a deal of misunderstanding in regard to the cost of steam horse power. Almost all of the figures upon which the cost of steam horse power is based are taken from large plants producing from 1,000 to 1,500 horse power. There is no question but that in large units like these a steam horse-power can be produced from $22 to $26 per annum. This is not true, however, of smaller plants. In the last few years, says Wm. O. Weber in the Engineer, I have had occasion to make up the figures as to costs of power on a number of small plants, and as a result of those figures I would submit the following table. In this table it will be seen that, while a 1000-horse-power installation of boilers, engines, buildings, chimney, and all other accessories, costs about $60 a horse-power, the same installation for 300 horse-power costs at least double per horse-power. It has been found by these figures that the interest on the first charges should be 14 per cent., of which interest is 6 per cent., depreciation 4 per cent., repairs 2 per cent., insurance 1 per cent., and taxes 1 per cent.

The attendance varies very largely with the size of the plant. In a 1,000-horse-power plant, three men in the boiler-room during the day at $1.50 a day, and one night man at $1.50, would be only $1.85 per horse-power. One engineer at $3 per day and an assistant at $2 per day would only be $1.54 per horse-power. I have allowed, however, $3.50 for attendants, instead of $3.39, which this would amount to. On the other hand, in a 100-horse-power plant an engineer at $2.50 a day would be $7.72 per horse-power, and a fireman at $1.50 per day would be $4.62 a horse-power, amounting to a little over $12. I have, however, called the figure $12, and proportioned this attendance for the other amounts of power in a ratio which would apply to the different sizes of powers and numbers of attendants required.

The cost of oil, waste and supplies is also similarly proportioned, and the results check very closely with those found in my average practice.

Some little time ago, I averaged the figures of a number of estimates made by several different authorities, with the following results: 100 horse-power, $63; 200 horse-power, $45; 300 horse-power, $37; 400 horse-power, $32; 500 horse-power, $29; 600 horse-power, $28; 700 horse-power, $27; 800 horse-power, $26; 900 horse-power, $25; 1000 horse-power, $24; 1,500 horse-power, $22; 2,000 horse-power, $21.

These figures are undoubtedly correct for the larger horse-powers, but are too low for the smaller power, principally because they have been based on mill plants, where better types of engines prevail, and more attention is given to economical administration.

I believe, however, that my figures will more nearly respresent average conditions throughout the country. Slide valve engines of from 100 to even 300 or 400 horse power are still largely used, and as economical results cannot be obtained from them as from the Corliss type of engines, so prevalent in eastern mill practice.

COST OF ONE HORSE POWER, 10-HOUR BASIS, 308 DAYS PER ANNUM

Size of plant, h.p.	100	200	300	500	700	1 000	2,000
Cost of plant per h p. hour	$170.0	$146.00	$126.00	$96.00	$76.00	$60.00	$56 00
Coal per h.p., per hr., lbs.	7.0	6 5	6.0	5.0	4.0	2.5	1.5
Fixed charges at 14%	$23.80	$24 40	$17.65	$13.45	$10 65	$8.40	$ 7.85
Cost of fuel at $4 per ton	$38.50	$35.70	$33.00	$27.50	$22.00	$13.75	$ 8.25
Attendance, 10th basis	$12.00	$10.00	$ 8.60	$ 6.50	$ 4.70	$ 3.50	$ 3 00
Oil, waste, supplies	$ 2.40	$ 2 00	$ 1.72	$ 1.24	$ 0.94	$ 0.70	$ 0.60
Total	$76.70	$68.10	$50.97	$48.39	$38.29	$26.35	$19.70

The City Council of Sherbrooke, Que., have accepted the tender of R. Arkley for the building of a crib dam at the Westbury Basin water power, his figure being $38,000. It is proposed to proceed with the work immediately and to call for tenders at an early date for erection of power house and installation of machinery.

ANY NEW CUSTOMER

Who sends us an ORDER this month through this advertisement will be allowed an extra 10 per cent. Does it pay to advertise?

THE HILL ELECTRIC SWITCH CO., LIMITED

426 ST. PAUL STREET, MONTREAL

TRADE NOTES.

The Chase-Shawmut Company, manufacturers of electrical specialties, Boston, announce the removal of their office and factory to Newburyport, Mass.

The Bradley, Levy & Weston Machinery Company, Toronto, have purchased the Canadian patents of the Automatic Smoke Prevention Company and will manufacture this device.

Owners of central stations will be interested in the special offer made by the Hill Electric Switch Company, of Montreal, in their advertisement in this number. Companies who may contemplate installing new switchboards can save money by communicating with the Hill Electric Switch Company, mentioning their advertisement in this journal.

An order for three steam turbines of the largest size has recently been placed with the Westinghouse Mechine Company, East Pittsburg, Pa., by Westinghouse, Church, Kerr & Company, acting as engineers and constructors for the Pennsylvania Railroad in connection with the New York Terminal equipment. These machines will form the initial installation in the new Long Island power house.

Attention is called to the advertisement of Hart & Company, Chicago, in this number, of the biggest little thing on the market. This is their "Red Cross" lubricant for commutators. All engineers should get a trial stick of this scientific preparation, which is very different from so-called compounds, and which is endorsed by many prominent electricians. It lubricates, preventing wear and cutting, and dissipates any sparks, preventing eating away of commutator bars and brushes.

There are all sorts of boiler compounds, but none like that made by the International Boiler Compound Company of Chicago. This compound attacks the minerals in the water, destroys their hardening qualities and prevents them from forming into scale. It removes rust, prevents corrosion, pitting, and preserves boiler iron. From 25 to 75 per cent. in running expenses is saved by those engineers who use this compound, besides the life of the boiler. See the advertisement in this number and send for a trial.

The Thos. E. Clark Wireless Telegraph-Telephone Company, of Detroit and Pontiac, Mich., announce that their business for this fall and winter looks exceedingly encouraging, what with getting out instruments for two stations for the government work at Washington and Baltimore, and numerous orders for colleges, universities, high schools and individual sets for short distance, keeps them busy to the full capacity. At the present time this company is moving into their new factory located at Pontiac. They are preparing instruments to be used at the Universal Exposition at St. Louis, where they will have three stations in constant operation. This company is hardly a yearling, and is known all over the globe, as orders and communications will show. It is the only manufactory of the kind in the world. The company is now looking for students to take up wireless telegraph operating; they state that they will guarantee a position to every worthy student who by his energy and ambition becomes an expert in the operation of the "Clark" system.

PUBLICATIONS.

Charles C. Moore & Company, of San Francisco, have published a book descriptive of the steam and power plants of the Pacific coast, many of which have been installed by them. There are many splendid illustrations.

John Wiley & Sons, New York, have issued the first edition of the "Text Book of Electrical Machinery," by Harris J. Ryan, M.E., Henry H. Norris, M. E., and G. L. Hoxie, M. E., Ph.D. Volume 1 covers the law of the electric magnetic and electrostatic circuits in such a manner that the analysis of the structural and performance characteristics of electrical machinery, treated in the following volume, may be easily followed. Bound in cloth, the book sells for $2.50.

A book for which there should be a large demand at the present time is Robert M. Nielson's "Steam Turbine," published by Longmans, Green & Company, 39 Paternoster Row, London. The second edition has just been issued, and in it are described the various types of steam turbines that have been invented. A chapter has been added dealing with the question of the saving of space obtained by employing high speeds. The price of the book is ten shillings six pence.

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NEW ELECTRIC AND GAS BURNERS.

Two sets of cotton, ramie, or silk threads are used in the manufacture of a new German metallically skeletonized earthy incandescent structure for electric lamps and gas or vapor burners. One set is impregnated with a solution of nitrates of refractory oxides, while the other set is treated with such salts of the platinum group as are capable of leaving behind a body of homogeneous metal when exposed to a moderate heat; such, for instance, as tne compounds formed by the metals or their halogens with aliphatic sulphur derivatives, particularly the nitrates of the sulphine salts. The impregnated threads are well dried, and compound threads are formed in which threads of the first kind are coiled round so as to cover threads of the second kind. These are then formed into the required shape and exposed to a calcining heat to burn the fiber, to reduce the platinum salts to the metallic state, and to convert the earthy salts into oxides. The structure obtained is finally treated with a solvent for removing the oxide crust.

The Hamilton Cataract Power, Light & Traction Company of Hamilton, Ont., are substituting aluminum for copper conductors on one of their lines between their generating station and the receiving station, a distance of 33 miles. The size of this line is 480,000 circular mills bare, spaced 40 inch equailateral triangle, and insulated for 40,000 volts, with a barbed ground wire at the centre of the triangle. Messrs. Woodman Bros., of Hamilton, are executing the work.

SPARKS.

It is reported that the Stark Electrical Company intend building a power house at Lambton, Ont.

The Dowd Milling Company have taken over the electric light plant at Pakenham, Ont., and intend furnishing an all night service.

The St. Cesaire Hydraulic Power Company have their power house at St. Cesaire nearly completely and will be in a position within a month to furnish electric energy to St. Johns, Que.

Messrs. Tobin & McCrea, of Richmond, Que., have obtained an option on a water power on the St. Francis River, near Ulverton, which they are considering the advisability of developing.

The telephone line from Shelburne to Hornings Mills, Ont., owned by Mr. S.F. M. O'Flynn, of Shelburne, and Dr. Moore, of Hornings Mills, has been purchased by the Bell Telephone Company.

The town of Dauphin, Man., is willing to grant franchises for the installation of electric lighting and telephone systems. Particulars may be obtained from Mr. William Rintaul, Drawer 3, Dauphin.

The Lincoln Light & Power Company, of St. Catharines, Ont., have practically completed the reconstruction of their lighting system. The new lamps were manufactured by the Western Electric Company, of Chicago, and are of the enclosed series alternating type, of 2,000 candle power each. Each lamp is enclosed in two globes, one inside the other, and it is claimed that they burn more steadily and diffuse the light better than the old style lamp.

WANTED—Six Second-Hand Six-Ampere Serial Arc Lamps; Bertram Engine Works, Toronto.

13 PICAS ON COPY

Eighty-five per cent. of the people who bought Pittsburg Transformers five years ago are buying them to-day.

The R. E. T. Pringle Co., Ltd.
Montreal Toronto St. John
Sales Agents.

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Direct Connected Generators
For Railway, Lighting and Power

Belt Driven Generators

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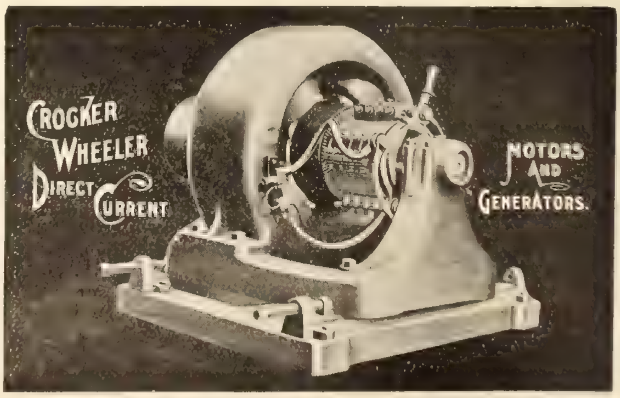

PERSONAL

Mr. H. M. Shipe has been appointed Fellow in Electrical Engineering at the Toronto School of Practical Science, while Mr. Silas B. Wass has been made Fellow in Mechanical Engineering.

A lamentable accident occurred at St. Catharines, Ont., on October 16th, when Mr. A. J. Markle, superintendent of the Lincoln Light & Power Company, was instantly killed by coming in contact with a live wire.

Prof. Galbraith, principal of the School of Practical Science, Toronto, has received the degree of L.L.D. from Queen's University. Upon his return to Toronto he was given an enthusiastic reception by the Engineering Society and students of the school.

Mr. W. H. Reynolds, lately with Mr. John Forman, Montreal, has accepted a position with the Canadian General Electric Company and will in future represent them in the Province of Quebec. Mr. Reynolds has a wide acquaintance among the electrical fraternity and will no doubt do yeoman service in his new capacity.

Mr. James Kent, manager of C. P. R. Telegraphs, has announced the following appointments: Mr. W. J. Camp, electrical engineer in charge of all electrical equipments, with office at Montreal; Mr. J. F. Richardson, superintendent eastern division, with office at Montreal; Mr. P. W. Snider, superintendent Atlantic division, with office at St. John, N.B. The latter division comprises all lines east of Megantic and Riviere du Loup, Que.

Mr. W. McLea Walbank, of Montreal, returned about October 1st from a trip to Great Britain and the Continent. Mr. Walbank states that in London he was surprised to find that the telephone was not in very general use. He was delighted, however, with the underground electric railway, known as the two-penny tube system, which is under the management of Mr. Granville Cunningham, formerly of the Montreal Street Railway. In Switzerland, he says, electricity is used in a surprising manner for propelling cars up very steep mountain sides.

The observation tower that has been a feature of the Tower Hotel at Niagara Falls since 1893 is being taken down and the material will be used by the American Wireless Telegraph Company in building its tower at the World's Fair.

An attractive booklet entitled "About Track Cleaning Devices," has just been issued by the Canadian General Electric Company. It is devoted to illustrations and descriptions of the Monarch track cleaner and adjustable track brush holders and brooms, now largely used by street railways. Persons needing track cleaning devices are advised to place their orders early so as to ensure delivery when required.

FOR SALE AT A BARGAIN

20 Shallenberger Recording Ampere Meters, manufactured by the Westinghouse Electric & Manfg. Co., 10 and 20 amperes, 16,000 alternations. Write to the BRANTFORD ELECTRIC & OPERATING Co. (Limited), Brantford, Ont.

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2-12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.

The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address

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SEND FOR TABLE OF CONTENTS

AN APPALLING CALAMITY

Our travelling represetative, who is now in the United States, writes us regarding the awful railroad disaster which resulted in the death of eighteen or twenty students of Purdue University, at Lafayette, and the injury to fifty others. The disaster occurred to a Purdue special train conveying the football team with nearly one thousand students and friends to Indianapolis. Our representative was on the scene a couple of hours after the wreck occurred, and states that a large number of the young men killed and seriously injured were students in the electrical science and electrical engineering classes at Purdue, at the head of which is Prof. Goldsborough. Many of them were in the sophomore as well as the freshmen classes, and some had been working with the Atlas Engine Company and other large works during vacations simply to obtain practical electrical knowledge.

SPARKS.

The Bell Telephone Company expect to reach Edmonton, N.W.T., with their long distance line from Cardston next month.

It is stated that the British Government has appointed a special committee to investigate the suitability of steam turbines for trans-Atlantic service.

For the first time the ship canal between Montreal and Sorel, Que., was illuminated electrically on October 29th, making it equally as navigable at night as during the day. Early next season the river will be lighted as far down as Quebec.

The Dominion Government steamer Aberdeen left Quebec about the middle of October for Belle Isle, carrying nine miles of copper wire to establish telephonic communication between the ends of the island, which is a mass of rock, partially covered with moss and producing no wood of any kind. As there are no poles to string the telephone wires from, it will be insulated and laid over the ground.

A few days ago a number of Chicago aldermen were in Toronto looking into the operation of the street railway, telephone and other public conveniences. They express surprise regarding the low charges for telephone service, stating that in Chicago an unlimited service such as is provided in Toronto costs a great deal more than $45 a year. The result is that there are comparatively few who patronize that department of the business.

TRADE WITH ENGLAND

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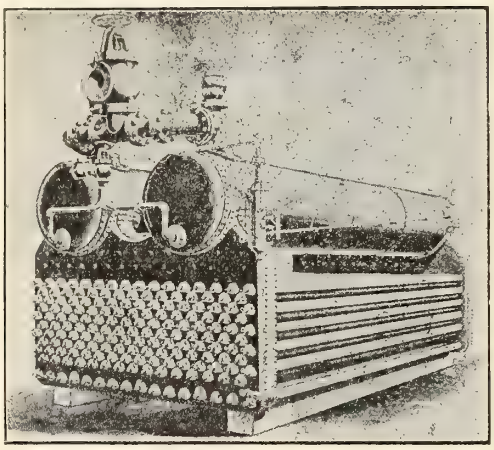

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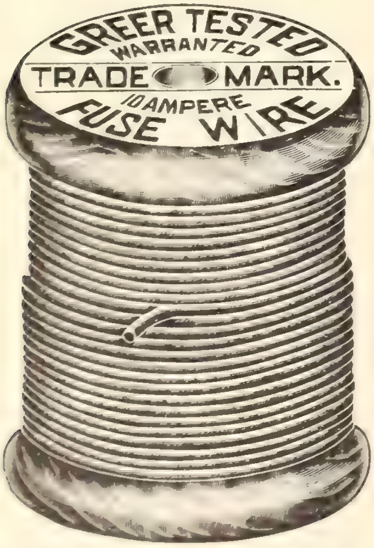

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SPARKS.

Contracts are about to be let for the electric plant for the Collingwood Furniture Company at Collingwood, Ont.

The Light Commissioners of Berlin, Ont., have just taken tenders on the supply of 655 cedar poles for electric line construction.

The contract for the erection of a power house for the town of Oshawa, Ont., has been given to Mr. Thomas G. Deverell, of Whitby, at the price of $5,155.

Mr. R. S. Kelsch, electrical engineer, of Montreal, has been engaged by the City Council of Ottawa to report upon the system employed in that city for the distribution of electricity.

It is announced that a five-mile extension will be made to the Scarboro Electric Railway, carrying it to Highland Creek. The old portion of the road will be reconstructed. The line is owned by the Toronto Railway Company. It is also stated that the extension of the Metropolitan Railway from Newmarket to Jackson's Point will be proceeded with immediately.

It is reported that the Toronto Electric Light Company have secured the services of an electrical expert to examine their plant and suggest any alterations or improvements that may be rendered necessary by the transmission of power from Niagara. It is the intention of the company to have the plant in readiness to utilize the power as soon as it can be obtained.

Clarkson School of Technology Thos. S. Clarkson Memorial, Potsdam, N.Y.

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ELECTRICAL REPAIRS.

In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

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have arranged their works for repair work only. They keep armatures of nearly all makes of dynamos in stock, which they loan while repairs are being made. Their factory is so arranged that they can run night and day, and work can be finished in the shortest possible time. Telephone Main 3149.

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The construction throughout, except the tube sheets, is cylindrical and spherical, requiring no stays; the boiler is supplied with an outer steel casting or for brick setting as desired by the customer.

The steam and water space is divided between two cylindrical shells, the thickness of plate is not so great as in the Scotch marine type, and the expensive and troublesome rear combustion chamber is avoided.

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SPARKS.

The City Council of Stratford, Ont., have given a fifty-year franchise for an electric railway to the Stratford Radial Railway Company.

The salary of Mr. Peter Ritchie, superintendent of the Orillia power plant at Ragged Rapids, Ont., has been advanced to $1,200 per year.

Mr. F. H. Dickenson, of Hamilton, is building the addition to the power house of the Cataract Power, Light & Traction Company at DeCew Falls.

The improvements to the electric and gas plants at Berlin, Ont., are to be pushed forward without delay. The Commissioners have awarded the contract for two generators to the Bullock Electric & Manufacturing Company, of Cincinnati, and that for three gas engines to the Westinghouse Company.

The American Cereal Company's new dam at Peterborough, Ont., will be six feet higher than the old one of the Dickson Company, thus the water in the pond will be raised as many feet. A special sitting of the county court is in consequence being held for the purpose of trying the right of the Cereal Company to raise the water, and to fix the compensation to be paid property holders affected.

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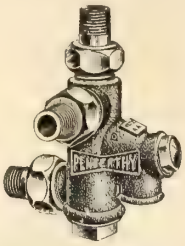

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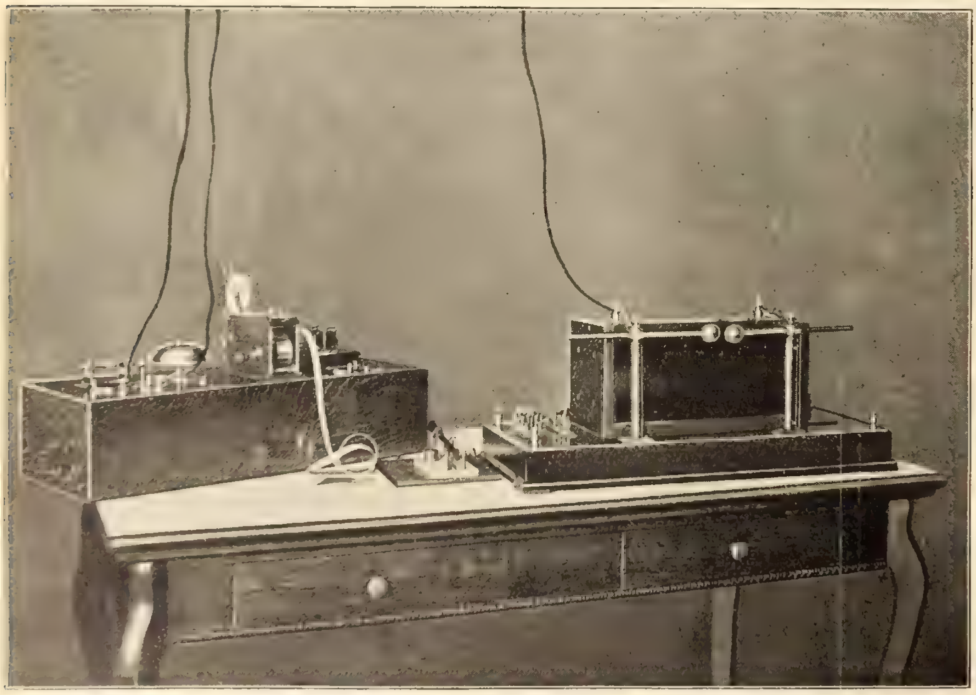

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SPARKS.

The electric plant at Petrolea, Ont., is to be remodelled.

The new power house of the Canadian Pacific Railway at Fort William, Ont., is nearing completion.

Mr. E. Thompson, assistant engineer in the power house at Fergus, Ont., was caught in a driving belt and killed.

On November 10th the ratepayers of Wingham, Ont., will vote on a by-law to purchase the electric light plant for $30,000.

The Arnprior Electric Light Company, of Arnprior, Ont., have been asked at what price they would sell their plant to the town.

The new public library building at St. John, N. B., is to be wired for electric light, the architect, Mr. G. E. Fairweather, having just taken tenders.

The Montreal Light, Heat & Power Company is understood to be negotiating with the Shawinigan Power Company for an additional power supply of 10,000 horse power.

A settlement has been reached in the dispute arising out of the arbitration to fix the value of the electric light plant at Midland, Ont. The Midland Electric Light Company receive the sum of $12,000 and are allowed to retain the large boiler.

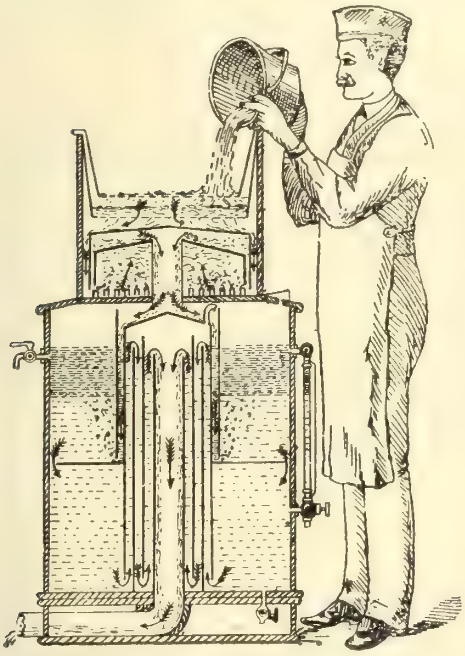

PLATE 2, Sectional View of Filter.

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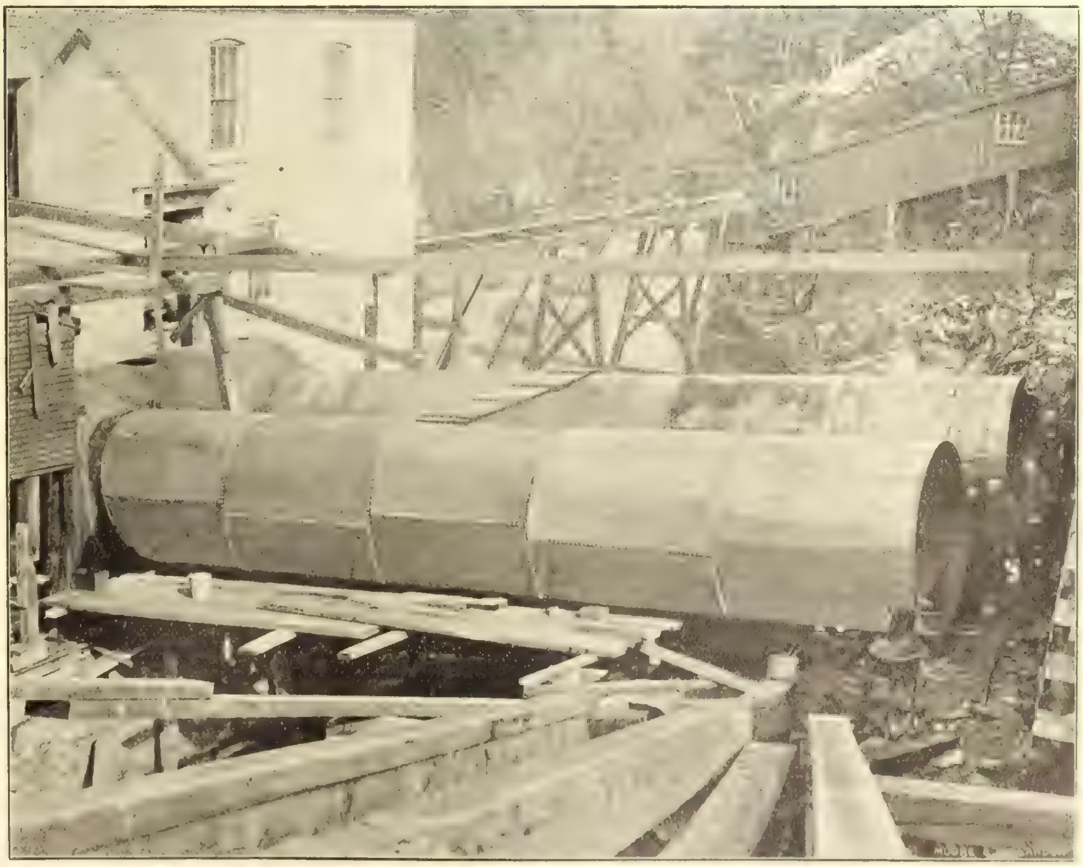

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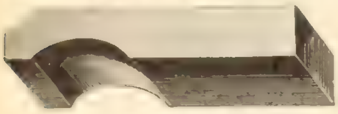
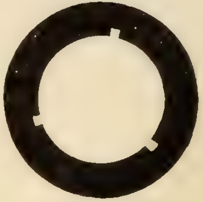
SPARKS.

The ratepayers of Almonte, Ont., last month carried a by-law to provide $5,000 for improvements to the electric light plant.

Tests have just been made of the new electric pump installed at the high level reservoir at Montreal. Its capacity is 5,000,000 gallons of water per day.

Mr. Clair, formerly engineer of the Wentworth street sewage disposal works at Hamilton, recently had one of his legs amputated as the result of gangrene.





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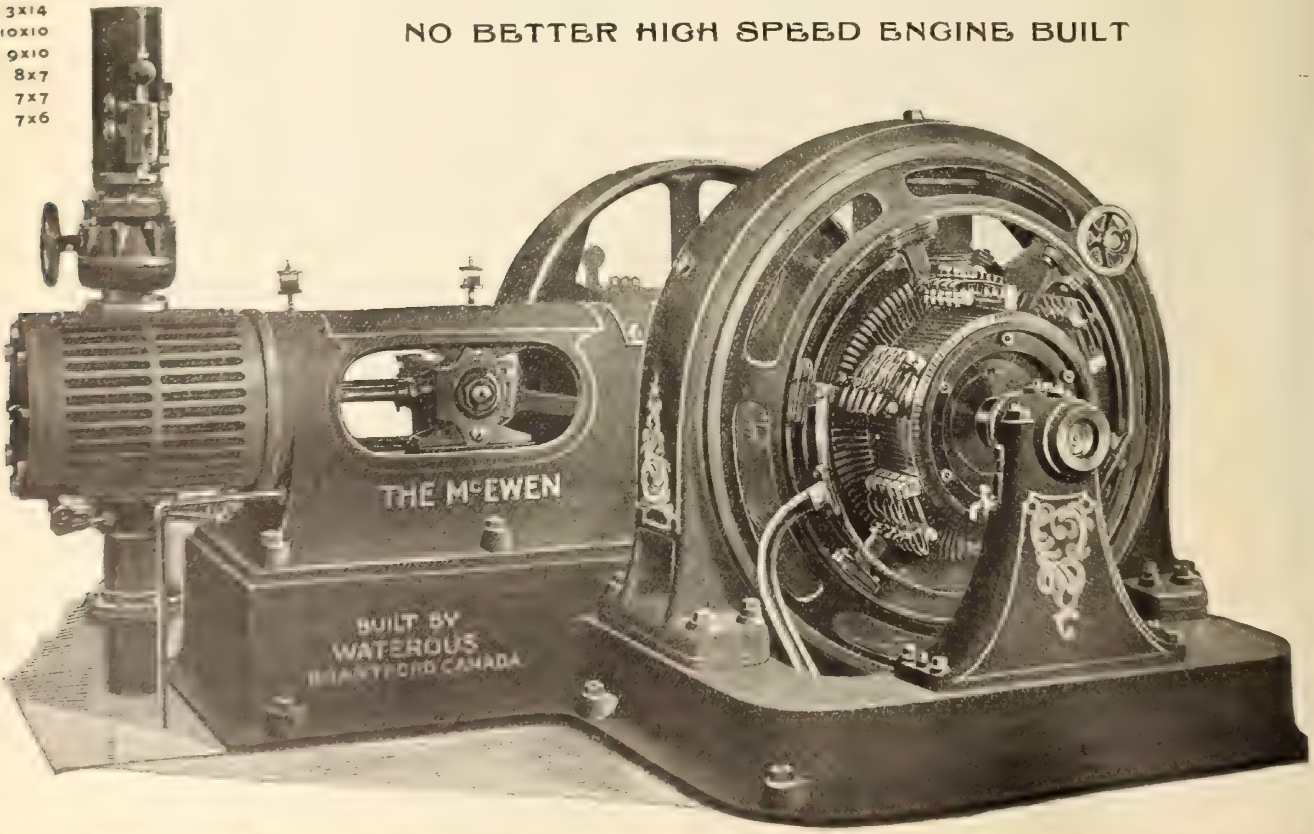

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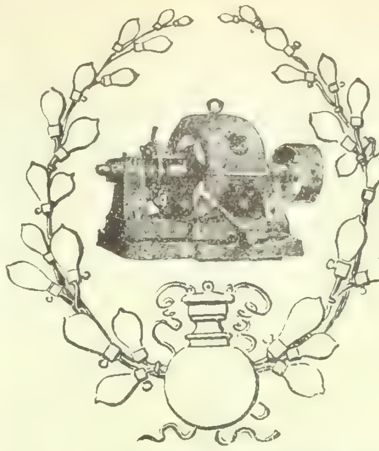

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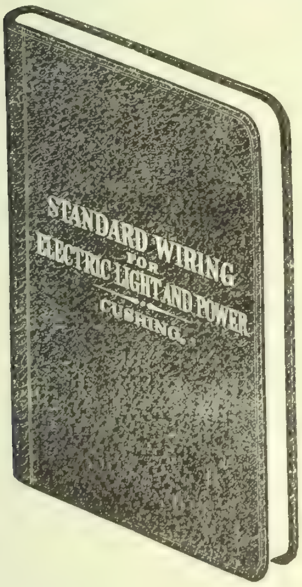

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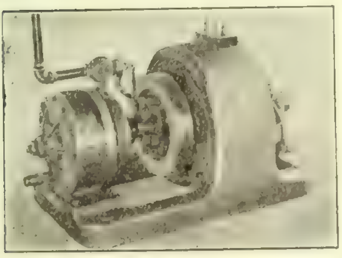

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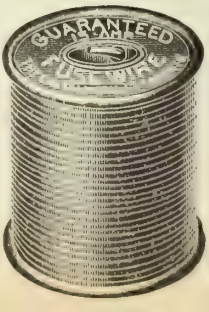

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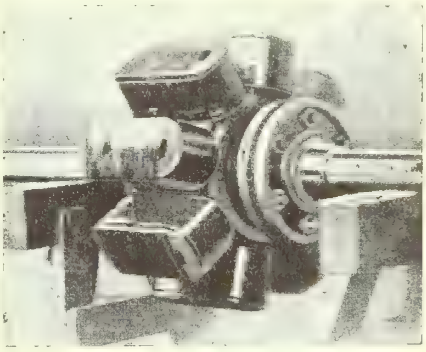

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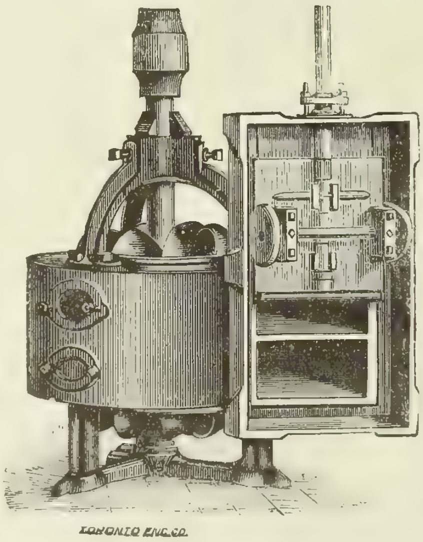
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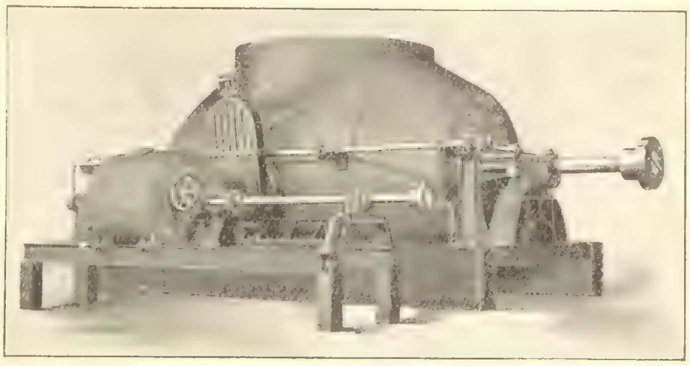

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The Hill Electric Switch Company, Limited, has so often been confused with the W. S. Hill Company, of New Bedford, Mass., U.S.A., that a few words regarding the Hill Switch Company and wherein it differs may not be amiss at the present time. The first point in favor of the Hill Electric Switch Company, Limited, and wherein its superiority in one way lies over its namesake, is that it is purely Canadian, being composed of local Montreal capitalists. The firm have been in the manufacturing business now for nearly two years and is duly incorporated according to law, with ample capital for their requirements. That their product gives satisfaction is proven by the numerous orders filled and unfilled received from some of the best known electrical firms, reaching from Vancouver to Halifax. Their workshop is well equipped with machinery of modern type and carries a competent staff of over 20 skilled mechanics. Mr. M. J. Doherty, the secretary-treasurer and manager of the firm, is a man of well known ability, of about 36 years of age, and who was for some time in the accounting department of the Canadian Pacific Railway and later did an accountant's business himself. His experience will make him valuable in the office which he rules and finances will be carefully controlled under his able management.

The practical partner is Mr. Geo. H. Hill, vice-president and superintendent, a man of about 37 years of age, who has been long and favorably known to the electrical fraternity. Mr. Hill served in the old days in Montreal with the "Phœnix" and "Thomson-Houston" companies, which became merged with the Royal Electric Company (now the Montreal Light, Heat & Power Company). After being with the Royal Company some time Mr. Hill took a leading position with Mr. John Forman, dealer in electrical supplies, which he held for about nine years. He, therefore, ought to know what customers desire, and as evidence can point to some prominent switchboards in Montreal, such as that of the new Montreal Board of Trade Building, The S. Carsley Company, and others.

The Hill Electric Switch Company do not make a general line of electrical supplies but confine themselves strictly to the manufacture of switchboards, switches and panels, and therefore may be looked upou as specialists in their line. They have a large local trade in Montreal from contractors, railway companies, etc. and they also manufacture heavy duty panels for some of the power supplying stations in Montreal and vicinity. Their place of business is centrally located at No. 426 St. Paul street, Montreal a nda cordial invitation is extended to any members of the electricl fraternity to drop in and see them.

PACKARD TYPE "G" METERS ABROAD.

A recent order received from abroad by the Packard Electric Company, St. Catharines, Ont., was for 8,000 of their Type "G" recording watt meters, delivery extending over several years. This order is probably the largest ever received by any Canadian electrical concern for meters, and the size of the order is an eloquent testimonial as to the superiority of the meter. Several orders have been received by this company from within the Dominion for similar make of meters, the orders ranging in size from 500 to 800 meters each.

Any corporation or central station figuring on installing watt meters would do well to investigate the merits of type "R" before placing their order. The Packard Company are so confident as to the superiority as to accuracy, sensitiveness and permanency of calibration of type "R" that they are always glad to send a meter on approval and for an extended and severe trial.

W. A. Smith is developing a water power at Renfrew, Ont.

A meeting of the shareholders of the Stave Lake Power Company, Limited, was held in Vancouver, B.C., on November 18th to consider the advisability of extending the option that has been given to Charles H. Baker, of the Snoqualmie Falls Power Company, which expired on November 1.

The thirty roadmasters employed by the Toronto Railway Company have presented Mr. A.M. Smith with a handsome smoking set as a recognition of his services in instructing them in electrical matters. Mr. Smith had just completed a series of lectures on the subject of electricity as pertaining to the work of the roadmasters.

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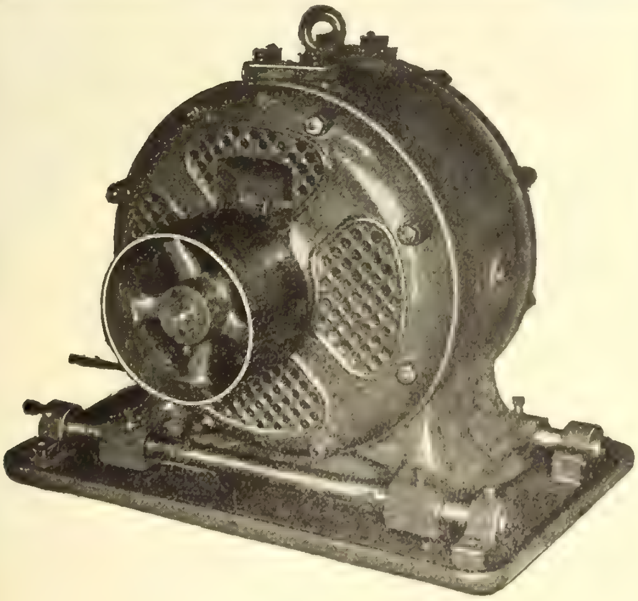

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SPARKS.

R. Hammond has started business as a dealer in electrical supplies at Fernie, B. C.

The Ontario Traction Company, Limited, propose to construct an electric belt line railway between Windsor and Tecumseh, Ont.

Some of the citizens of Magnetawan, Ont., are forming a company to install an electric plant for lighting the streets and for commercial service.

Mr. McKay, chief electrical engineer of the Bell Telephone Company, is superintending the installation of a new switchboard in the company's exchange at Victoria, B. C.

The Canadian General Electric Company, of Toronto, have secured the contact for supplying new arc lamps and other electrical apparatus for the electric light plant at Moncton, N.B.

The Dominion Government will send an engineer to inspect the St. Andrews Rapids at Winnipeg and report whether the water can be dammed for power purposes without injuring too much land.

The Sackville Electric Light & Telephone Company, of Sackville, N. B., is now running between twelve and thirteen hundred lights and one hundred and seventy telephones. The new Ladies' College is to have 240 electric lights, for which the wiring is now being done.

The Toronto Technical School Board have sent a recommendation to the new Board of Eduction, which will have charge of primary, secondary and technical education, urging that the salaries of the teaching staff of the Technical School be placed upon the same level as that of the staffs of the collegiate institutes.

A company of Montreal and Toronto capitalists, represented by Mr. W. G. Tretheway, made application to the town of Edmonton, N. W. T., for an electric railway franchise. Public sentiment was against the granting of such privilege, and the citizens carried the following resolution: "That in the opinion of this public meeting the time is not opportune for handing over by the city of Edmonton the railway franchise to an outside company." Edmonton already owns and operates it waterworks and lighting plant.

The commerical telegraphers of the Canadian Pacific Railway at Winnipeg, numbering about 40, went on strike on November 17 on account of the company having discharged four men who were prominently associated with the organization of the telegraphers' union. A conference was held with Superintendent Jenkins, who agreed to take the men back, and the strike was called off within a few hours.

The Oriental Power & Pulp Company, a corporation of English capitalists, have taken the first step towards the building of large pulp and paper mills at Swanson Bay, in British Columbia. In connection with the project it is proposed to obtain power from Yule Lake, which will be dammed at the mouth of a small creek, a line half a mile in length carrying the water to the turbines in the power house. There is a fall of 371 feet between the lake and the power station site, and the engineers who have reported on the scheme state that 17,000 horse power can be developed at low water. The local managers of the company are McKinnon, Ferguson & Company, of Vancouver.

It is expected that the electric power generated by the Vancouver Power Company on the North Arm of the Inlet will be transmitted to Vancouver by the middle of December. Mr. J. Buntzen, general manager of the British Columbia Electric Railway Company and the Vancouver Power Company, states that the 2,000 horse power which will be then available will be sufficient to supply both the street and lighting systems and operate the street railway in Vancouver. The interurban line will continue to be operated from the Burnaby power house. The full capacity of the plant, which is estimated at 30,000 horse power, will not be available until the completion of the two and a half mile tunnel connecting Lakes Beautiful and Coquitlam, which is now about half completed.

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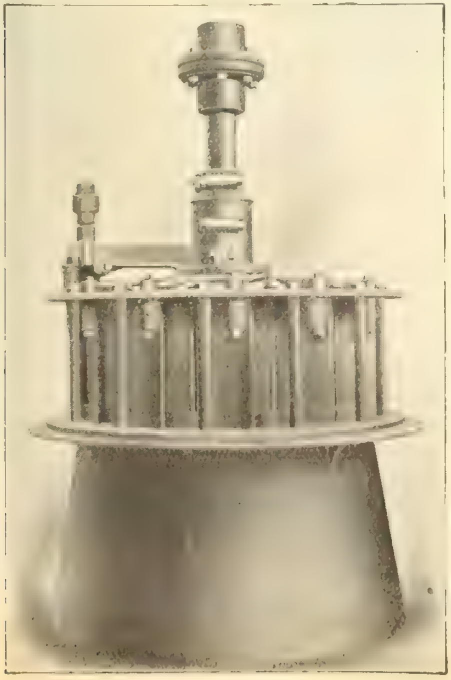

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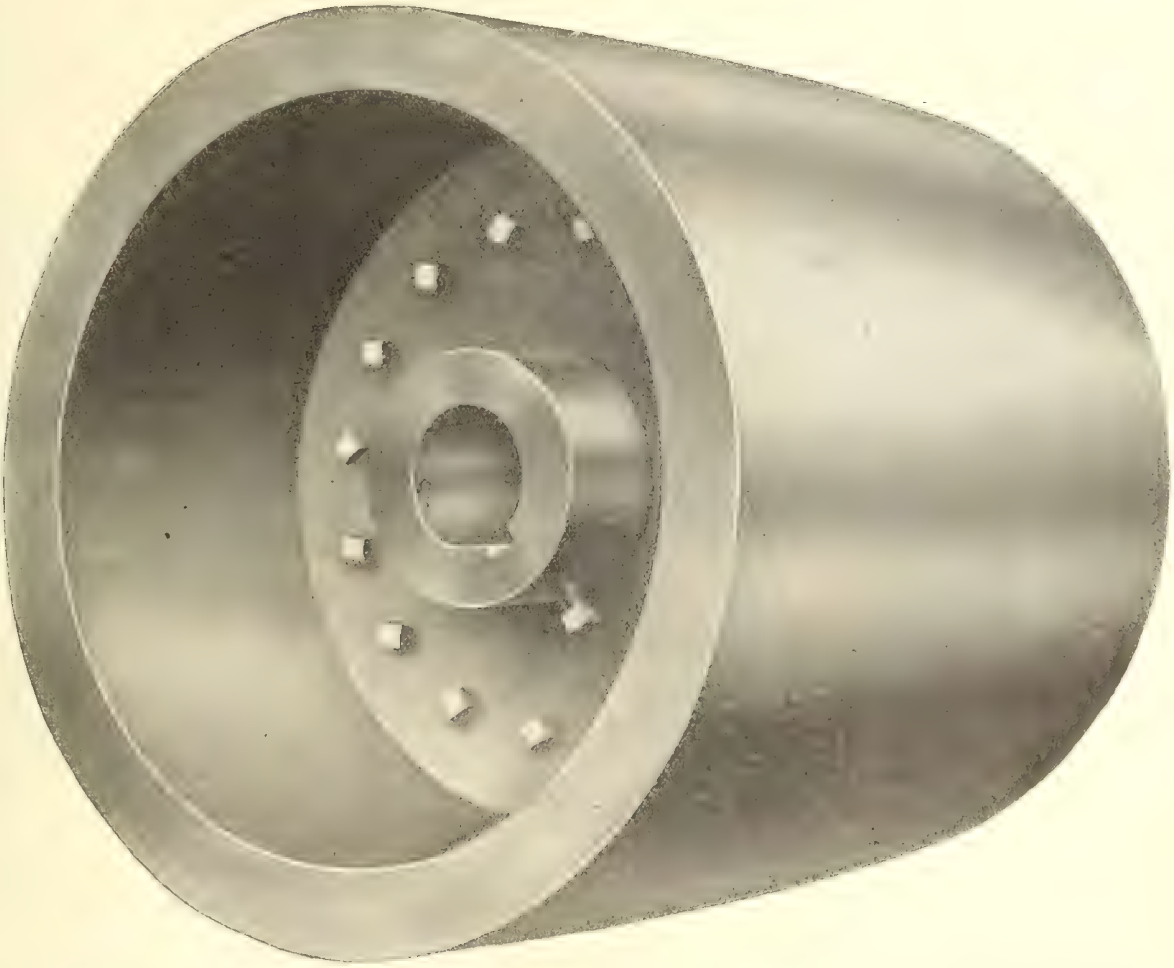

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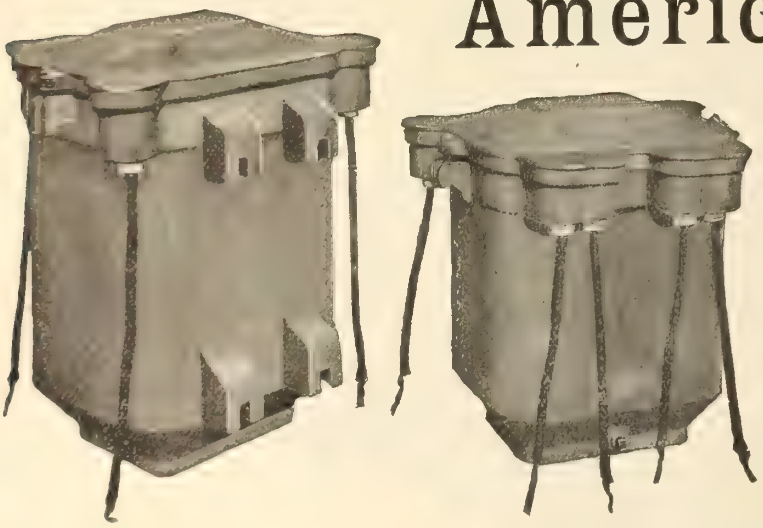

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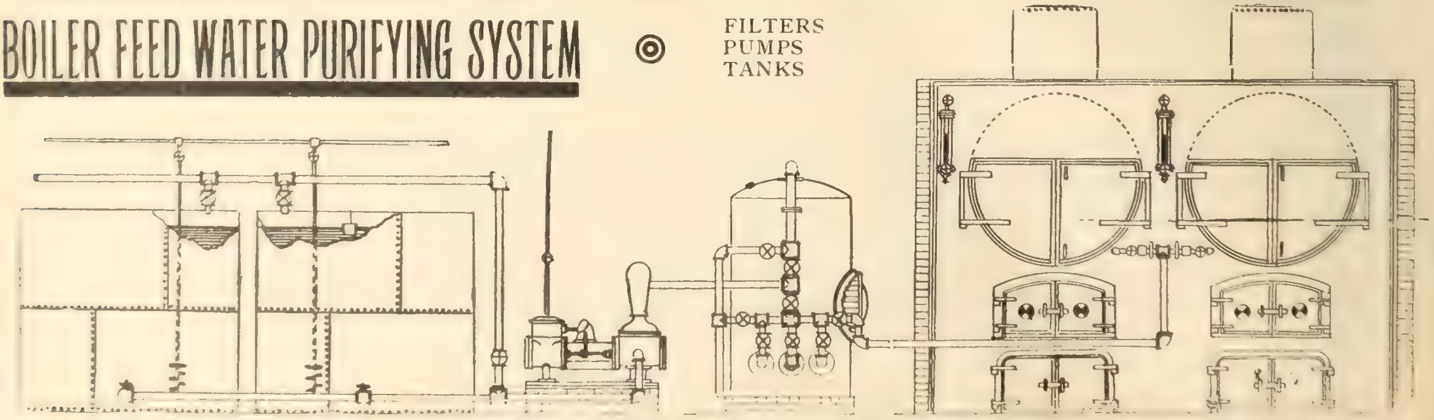

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CANADIAN
ELECTRICAL NEWS
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Vol. XIII. DECEMBER, 1903 No 12.

THE NEW COMPRESSORS OF THE GRANBY COMPANY AT PHOENIX.

By Geo. E. Cole.

Among the recent installations of power plants in British Columbia, the new air compressors of the Granby Consolidated Mining, Smelting & Power Company at Phoenix are noteworthy, and the fact that this is one of the largest plants of its kind in the province, and most modern in both its mechanical and electrical features, are reasons sufficient, perhaps, to justify a somewhat detailed description thereof.

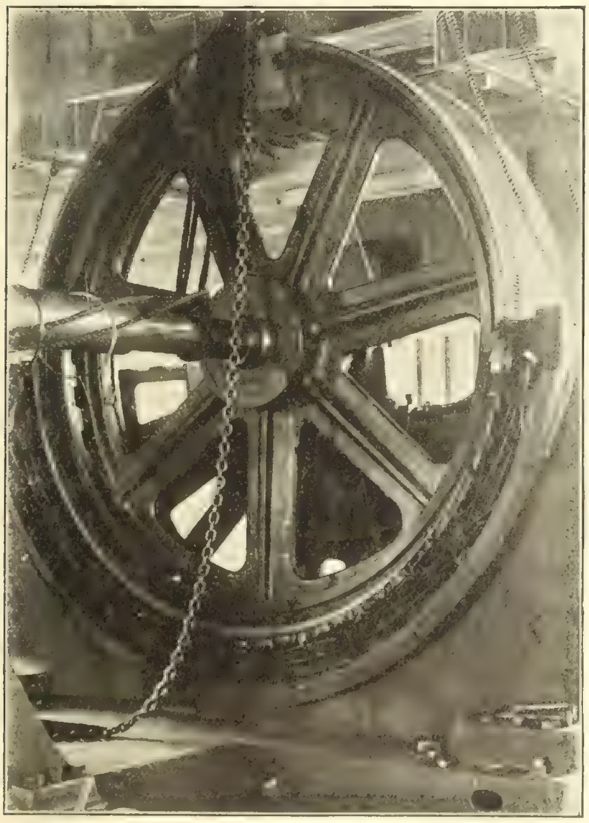

Fig. 1.—View of Motor Showing Revolving Part.

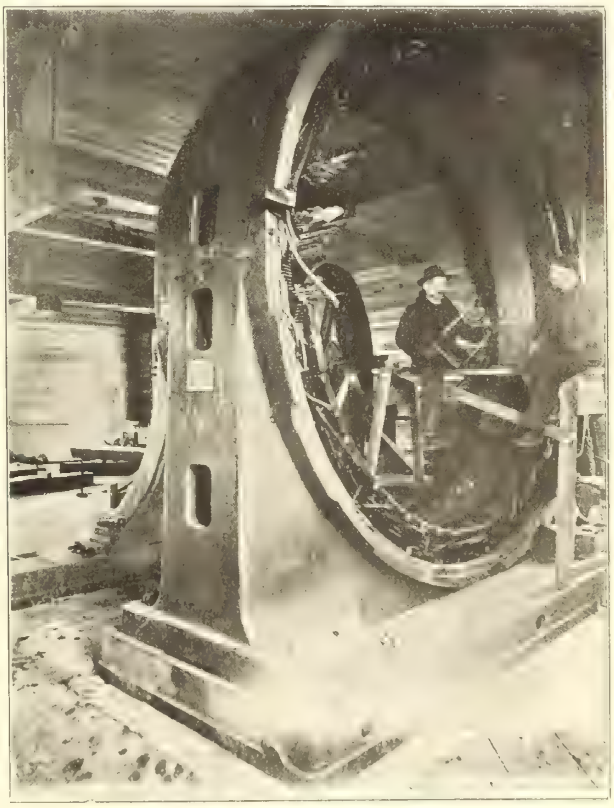

Fig. 2.—View of Motor Showing Primary Winding.

Some five years ago a 10-drill Canadian Rand air compressor was installed at the Old Ironsides No. 1 shafthouse. In 1900 another 10-drill compressor was placed in position at the Knob Hill. Before the installation of the new plant these two older compressors, hoisting engines and mine pumps were driven by steam. But the supply in the vicinity of timber for fuel purposes was rapidly becoming exhausted, with the result that steam-generated power was no longer economical. This fact, together with the large extension of operations at the mines, necessitated recently a larger plant and a change in motive power, and electricity was substituted for steam.

Power is now supplied to the Granby Company, by the Cascade Water, Light & Power Company so that, at the present time, electric motors drive the air compressors, which, in turn, supply the motive power for mine pumps and hoisting engines.

The new compressors were designed and constructed by the Canadian Rand Drill Company, of Sherbrooke, Que., and the motors were built by the Westinghouse Electric and Mfg. Company, of Pittsburg, Pa.

The superstructure of the building is of wood frame construction. The timbers used are 12x14 and the foundations of the building rest on solid rock. In appearance the exterior of the building is plain. The interior is finished in the same style, but the general arrangement of the machinery and fittings make its appearance attractive.

The general dimensions of the buildings are 120x60 ft. and the height under roof truss is 20 ft. The floors are of oiled wood, except where foundations of the

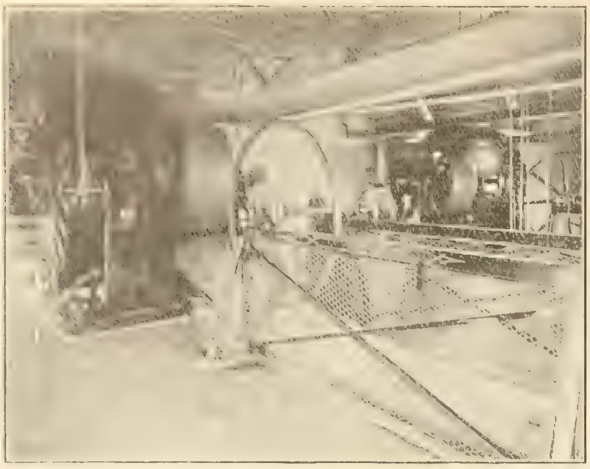

FIG. 3. MOTORS IN POSITION.

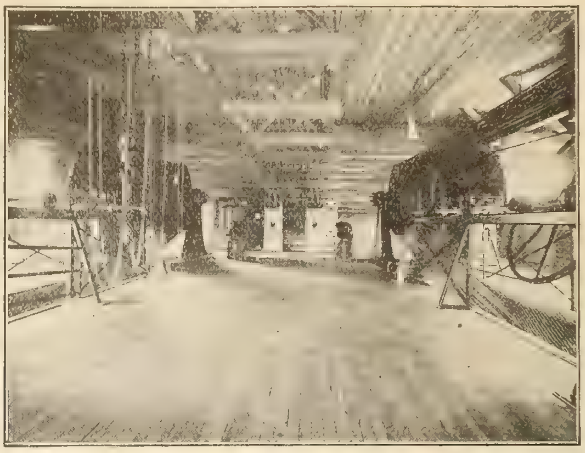

FIG. 4.—MOTORS, AUTO-STARTERS AND SWITCHBOARDS.

compressors project about five inches above the floor level.

Both compressors and motor foundations are of concrete and rest on solid rock. In the foundations of compressors, the concrete is eleven feet deep and motors rest on foundations of 7 foot depth. The wheel pits and rope driveways are also firmly lined with concrete.

A travelling crane, capacity 20,000 pounds, operated by hand chains, spans one side of the room and travels the whole length of same. The crane runways are supported from the cross beams by heavy iron bolts. A view of the crane may be had from Fig. 4. The crane can be transferred from one side of the room to the other, and this, in a short space of time, by means of a small car which travels between the runways of the crane.

The motors, two in number, rest on 13 foot square iron bases, which are bolted to the concrete. The height of the motors above the floor is 13 feet 6 inches. (Fig. 1, a photo taken when motor was being erected, gives an idea of the size of the revolving part, which is 10 feet in diameter and 24 inches wide. Fig. 2 is a view of the primary winding before the revolving part was mounted.

Both motors are of the induction, 3-phase, Westinghouse type C. Each is wound for 2,000 volts and 7,200 alternations per minute. The speed is constant at 200 revolutions per minute, and each motor has a capacity of 700-h.p. The drive wheels are 7 feet 8 inches in diameter and 48 inches wide. They are grooved for twenty-one 1½ inch ropes. Fig. 3 shows the motors in position. That on the left is in operation, as is seen from the appearance of the rope drive and tightener.

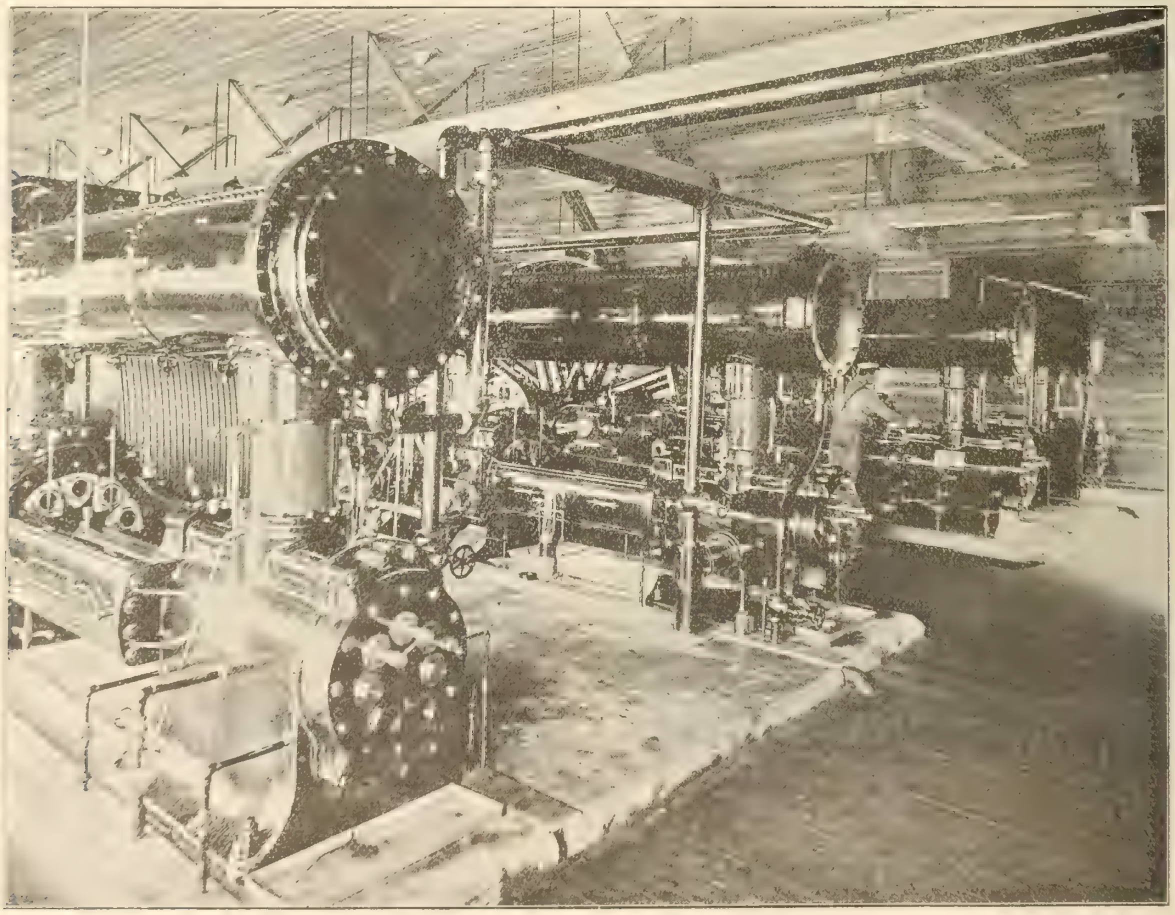

FIG. 5.—GENERAL VIEW OF COMPRESSING ENGINES.

Fig. 4, a view taken from the centre and opposite end of the room, shows the two motors, autostarters and switchboards. The well-known device of the Westinghouse Company is used in starting the motors. In connection with the controllers are two autotransformers which tend to take up any excess of current in the line, until the motor has reached its full speed. When the motor has started, the controller is then thrown on the line.

There are two switchboards, each motor having a separate panel. The third board, seen in Fig. 4, is that used for the lighting in the town. There are five instruments on each board—voltmeter, three ammeters and a watt meter. Directly above the switchboards the lightning arresters, the Westinghouse indoor type, are arranged.

The compressors are of the tandem duplex air type. The low-pressure cylinders are 28x36 inches and the high-pressure are 16x36 inches. The low-pressure cylinders are fitted with Corliss inlet valves and poppet discharge valves; the high-pressure cylinders have spring inlet valves and poppet discharge valves. Between the low and high pressure cylinders an intercooler is placed. Air is taken in to the low-pressure cylinder at atmospheric and compressed to 25 pounds pressure, at which it enters the high-pressure cylinder, when it is compressed to 100 pounds. This air is in turn discharged into an aftercooler where any heat is removed. From the aftercooler the air passes to a large receiver 16 feet long and 72 inches in diameter. Compressed air is distributed from this receiver by a main air line, which is 10 inches in diameter.

The low-pressure cylinders are lubricated from one reservoir, so arranged as to distribute the oil to both ends and also to the centre of the cylinders. Separate lubricators are used for the high-pressure cylinders Pillow blocks and all moving parts are fitted with sight-feed oilers. The crank pins have centrifugal oilers and the cross-heads a set of wipers.

Both compressors are equipped with a system of indicators whereby readings can be taken at any time showing the conditions of the valves and pistons. A gauge board at one end of the room has a high-pressure gauge, one high-grade clock, four low-pressure gauges, two revolution counters and one recording end test gauge. A set of thermometers is arranged on the low and high-pressure cylinders to indicate the effect of the cooling water in the intercoolers.

The low-pressure cylinders are water jacketed around both the cylinders and heads, but the high-pressure have jacketing around the cylinder only. The cooling water passes first through one intercooler, then through a second and finally through the cylinder jackets, which it leaves at 70 degrees Fah. A general view of the compressing engines is given in Fig. 5, in which the eight cylinders appear with the intercooler on top. The valve movements of the unloading device may be seen on the second half of the nearer compressor. Fig. 6 is a view of the engines looking towards the motors.

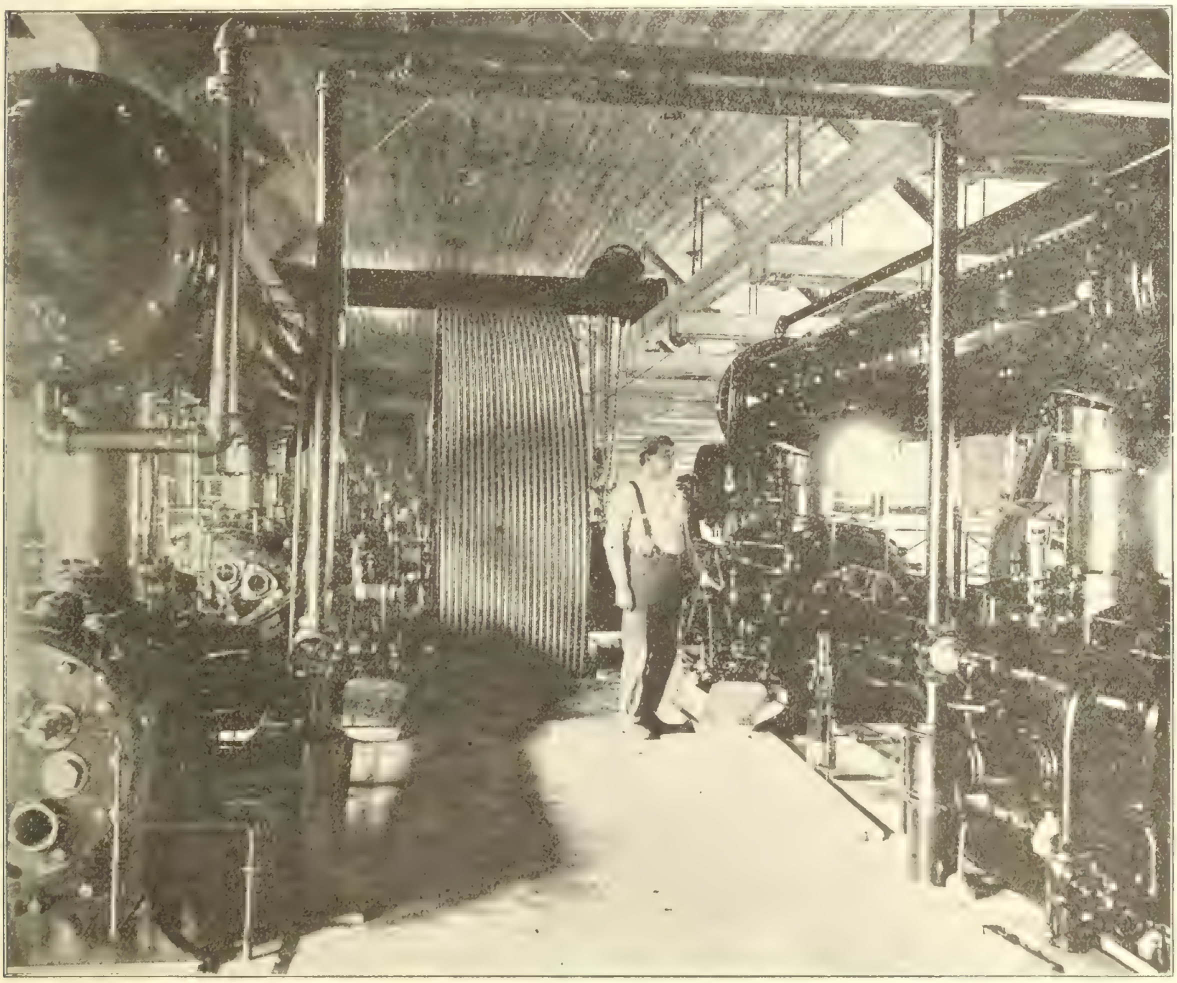

FIG. 6.—VIEW OF ENGINES LOOKING TOWARDS THE MOTORS.

The fly-wheels, one of which is shown in Fig. 6, are 18 feet 2 inches in diameter and 48 inches wide. Each wheel is grooved for twenty-one ropes of $1\frac{1}{2}$ inch diameter. The wheels make 80 revolutions per minute and the capacity of each motor is 4,220 cubic feet of free air per minute.

Each fly-wheel is driven from the motor by an endless rope which runs from the motor drive wheel to the fly-wheel. The distance from centre of motor drive to centre of fly-wheel is 60 feet. This rope drive is arranged with an automatic take-up whereby the tension of the rope is kept constant. The track, some 40 feet in length, for this tightener, rests on an iron frame which is fastened to the floor. Views of this tightening device may be had from Figs. 5 or 6. The tension weight is taken up through the ceiling and cannot be seen from the engine room.

In trial tests, the motors were started independently and run for twelve hours. The drive ropes were then put on to connect fly-wheels and motor drives. Each compressor was then run light for twelve hours. The load was thrown on the machines and they have been running almost continuously ever since. Indicator cards have been taken from time to time showing the machinery to be in first class condition. The readings prove the compressors to be doing all the work the makers claim for them. The motors are doing their work in the same highly efficient style.

CANADIAN ELECTRICAL ASSOCIATION.

A meeting of the executive committee of the Association was held in Toronto on Nov. 26th.

The secretary reported receipt of a cheque for $99.83 from the treasurer of the Local Committee, being surplus on hand from last convention. A vote of thanks was passed to the committee, and the suggestion approved that the money be devoted to entertainment purposes at next convention.

Messrs. R. G. Black, J. A. Kammerer, A. B. Smith, the President and Secretary were appointed a committee to procure suitable papers for next convention.

Mr. A.A. Dion, of Ottawa, was appointed editor of the Question Box, first introduced at the Toronto convention, and the funds necessary for the efficient prosecution of his work were voted.

Considerable discussion took place with regard to means whereby the usefulness of the Association might be increased. A number of suggestions were made, some of which will doubtless be acted upon. It was felt that the Question Box would prove a very valuable feature, and that the correspondence in connection therewith should be the means of bringing the members into closer contact, and awaken a greater interest in the organization. The members will also be asked to suggest means whereby the value of the Association to all its members may be increased.

THE NEWMARKET BOILER EXPLOSION.

The boiler explosion in the factory of William Cane & Sons at Newmarket, Ont., on November 18th was one of the most regrettable incidents that has occurred for a long time. The boiler which gave way was of 100 horse power and one of a battery of four. The centre of the large building was completely wrecked, the force of the exploding boiler being tremendous. Two firemen, name Frank Burch and Joh Agnew, were killed instantaneously, while nine other persons were more or less injured.

The evidence given at the coroner's inquest has not thrown much light on the cause of the explosion. It has been shown that no charge of negligence could be laid against those in charge of the boilers. The boilers had been regularly inspected by the Boiler Inspection & Insurance Company, the last inspection being on September 9. On that date the boilers were found in first-class condition. It is believed that the initial rupture in the boiler took place under one of the longitudinal seams of the middle section, and it is pointed out that no test could reveal a defect there. An examination of the plates and tubes showed no indications that the water was low in the boiler at the time of the explosion. From an accurate measurement of a portion of the plate near the break with a micrometer it proved to be above the standard thickness of boiler plates.

The coroner's inquest has not yet been concluded.

ELECTRIC POWER DEVELOPMENT FOR CALGARY.

The city of Calgary, Alberta, has under consideration an extensive water power development, a report upon which has been made by Mr. Roderick J. Parke, consulting electrical engineer, of Toronto. The power is to be obtained from the Kananaskis Falls, situated 54 miles west of Calgary and one-quarter of a mile north of the C.P.R. tracks. These falls are in the Bow river at its junction with the Kananaskis river. The available head is from 45 to 60 feet. At the former head the maximum amount of power constantly available is estimated at 15,300 h. p., and at the 60 foot head 24,000 h. p. It is estimated that the cost of plant to develop the full capacity under 60-foot head, with double transmission line, etc., would be $890,000. At present it is proposed to develop the full capacity at 45-foot head, but to render available at Calgary about 1,700 h. p., at an approximate cost of $260,000. The distribution is to be 40,000 volts, three-phase, 60 cycles.

The object of the development is to provide the necessary electric energy for street arc lighting, incandescent lighting, waterworks pumping and commercial power, and when the population shall warrant, for the operation of the electric railway.

The contract with the Calgary Water Power Company, Limited, expired on September 1st, 1899. It is understood that since that time the town has been working on a monthly contract basis, paying $6.50 per month for arc lamps of 1,200 c. p. for street lighting, all night service, on moonlight schedule. The price of Crow's Nest steam coal is $5.50 per ton in bins at Calgary.

The report of Mr. Parke will be considered at an early meeting of the city council, and it is expected that a by-law will be submitted to the ratepayers some time this winter to authorize the expenditure, and if carried the work will likely be commenced with as little delay as possible.

Calgary is a progressive city and has grown rapidly within recent years. The assessment of property in 1887 was $1,217,154; in 1902 it had increased to $2,380,825, while last year there was a remarkable increase, the assessment being $3,221,549. The indebtedness of the city is general debentures $288.500, and local improvement debentures $91,000. The value of real estate and buildings owned by the city is $90,000, the original cost of which was $49,675.

A project is now on foot at Brandon, Man., to harness the waters of the Assiniboine river and utilize the power for lighting and manufacturing purposes. The Government will be prevailed upon to declare the river an unnavigable stream from Brandon upwards.

POWER DEVELOPMENT AT KAKABEKA FALLS.

By F. E. Trautman.

All mention of the industrial development of the town of Fort William, Ont., naturally brings forward the question of the development of the water power at Kakabeka Falls. It seems to be centred in the minds of all who think of the location of any manufacturing at this point that the power must be first considered.

Twenty miles above the town of Fort William the waters of the Kaministikwia river plunge over a precipice 125 feet high known as the Kakabeka Falls. To adequately understand the amount of power contained in the river it will be well for readers of the Electrical News to know that the Kaministikwia river carries to Lake Superior the water from a water shed as large as the territory embraced in a line drawn from Lake Erie to Georgian Bay and thence westward to the Detroit river. It is the outlet of Shebandowan and Dog lakes, both bodies of water of enormous size.

Five miles from its mouth the Kaministikwia river is twenty feet deep and four hundred feet wide. These factors will show that the volume of water flowing over the falls is no inconsiderable quantity.

Kakabeka Falls, Near Fort William, Ont.

The first move that was made to bring the power of the falls to the town was in 1896, when E. S. Jenison, an engineer of Chicago, made surveys of the country and estimated that the water of the river, if properly harnessed, would produce sixty thousand horse power of electrical energy. Mr. Jenison went to the Ontario Legislature and secured the right for development of the water power of the Kaministikwia river and the right to expropriate lands in the vicinity that he might need for purposes of development. In 1898 Mr. Jenison, by a vote of the ratepayers, secured a contract to furnish water and power to the town, the price to be $10,000 per year. Mr. Jenison's scheme was to divert sufficient water from the river above the falls and from the small lakes and tributary streams to furnish water for domestic use to be supplied direct into the town and such power as might be needed for electric lighting and other commercial and manufacturing uses. The water was to be brought down in a canal to a point outside the town limits and there contained in a reservoir. Water for domestic use to be supplied direct into the mains of the town and enough head secured at the reservoir to drive dynamos for electrical energy.

The scheme of Mr. Jenison was never carried out, as his contract with the town lapsed and was not renewed. During the years that intervened between the time that Mr. Jenison first projected the development of the power and the consummation of the contract with the town, there were cases at law between himself and the company known as the Kakabeka Falls, Land and Electric Company. This latter company owns the falls proper, as the rights of Mr. Jenison did not cover the water actually flowing over the falls and the land on either side. Finally the atmosphere was cleared of lawsuits and Mr. Jenison again came forward with a proposition to the town, but it did not reach maturity and the Ontario legislature of 1902 took away the rights of Mr. Jenison to the water power and transferred them to the town of Fort William.

The town was now in a position to deal with capitalists and a bargain was made with the Anglo-American Power Company, which company had been formed to take over the rights of Mr. Jenison. An agreement was entered into between the company and the town, but was rejected by the Legislature, so that the spring of 1903 saw all power development schemes vanished, the town in possession of the right to develop the rapids above the falls but not in a position to do the work as a municipality. The Kakabeka Falls, Land and Electric Company s in reality the Clergue people of Sault Ste. Marie fame. In 1886 the land on both sides of the river at the falls was acquired by E. V. Douglass, of Philadelphia, for a long time president of the Clergue companies. It now seemed to be up to Mr. Clergue to make a move and during the past summer he came to the town with a proposition, asking the right to deliver power in the town. This has been granted but no further move has been made by Mr. Clergue. The two companies that fought so long have merged their interests and the town has agreed to relinquish its rights to the power provided the companies will proceed with development. The canal idea of Mr. Jenison has been abandoned and the development will be made at the falls and the energy transmitted to the town. The company has agreed to furnish the town with power at $18 per horse power per annum in return for the use of the streets.

It will be seen that in every move made for the development of this splendid water power the town of Fort William has been ready to join heartily, the main fact ever being before the people that development is what is needed, by whom the people are not concerned. The latest move was made by Mr. Clergue. Just who will make the next is not now known.

An advertisement in the Electrical News brings results.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Wireless Telegraphy. Wonder is being expressed at the dropping out of sight of Mr. Marconi and his trans-Atlantic and trans-Continental wireless telegraph projects. A year ago the chief topic of discussion in and out of the press was Mr. Marconi and his alleged wonderful discovery. For months past we have heard little about the man or his projects. Is this silence ominous of work being quietly done by the inventor towards the perfecting of his system for commercial use at an early date? Or does it mean that unlooked for and perhaps insurmountable difficulties have been encountered?

British vs. American Methods. "We turn out thirty five machines a day and sell in Great Britain ten thousand machines a year," remarked the representive of a large United States manufacturing concern the other day. When the writer began to catechise him with the object of learning what induced the Britishers to pass by the home manufacturer in favor of the foreigner, he was told that it was not because of the advantage of cheapness, as the price asked for the machines made in the States was as high as that of the British made machines. The American manufacturer's advantage was said to principally lie in two things:— freedom from everything in the form of red tape in his manner of doing business and greater perfection in shop methods in the direction of cheapening production. The American manufacturer has been driven by the high price of labor to devote much thought to means of accomplishing as much as possible by means of machinery, thereby reducing human instrumentality to a minimum. As a result it is claimed that cost of production has been so reduced as to far more than offset the advantage of cheap labor enjoyed by the British manufacturer. The fact that in an American manufacturing establishment six weeks were spent on the drawings of a machine which sells at $30, with the object of devising means whereby a flange might be placed on the end instead of on the side, thus enabling the parts to he put through without re-setting the planers, will serve to illustrate the care exercised in the drawing office. In this case no one will question the wisdom of the exenditure of $150 to discover means of effecting a saving for all time in the manufacture of even a low priced machine, the production of which, however, runs into thousands.

Trolley Catchers. Almost every day sees some device or other brought forward to minimize time or to lessen cost, and of these one which promises to come into extended use is the trolley catcher for street cars. Anybody who has stood at a city corner and watched a pole get loose among the overhead work will realize the large possibilities of a lovely tangle which it offers. No wonder that the conductor leaves change unmade and fares half paid and hustles for his trolley rope. Almost a worse wreck is the result of a trolley run off when the car is making time on a free stretch of track. The first machines brought out to overcome this difficulty were but partially effective, in that they did not act until the pole and wheel had risen some fifteen inches or so above the wire. While this, of course, was a great improvement over allowing it to rise to the full extent of the spring and pole, it still allowed it to project enough to present quite large possibilities of trouble. The natural step after these devices had showed that there was a field for such an instrument was to design apparatus which not only would prevent the trolley wheel and pole from rising but a few inches above the wire, but which would go farther and pull them down below it. The result of these efforts has been the placing on the market of several machines which accomplish this result, and thus leave the conductor perfectly free at all times to attend to his passengers. Not only this, as it is perfectly obvious that he cannot at all times be looking after his pole, it prevents damage from run offs at unexpected points, which must occasionally occur on even the best of systems. Most of the designs now on the market are reset, after the machine has pulled the trolley down, by hand, but at least one type uses compressed air for this purpose. They are a comparatively cheap form of insurance against not only the actual damage to the overhead equipment and the rolling stock, but, what in some cases is almost worse, interruptions to the schedule, which will doubtless lead many managers to include them as part of their standard car equipment.

Niagara Falls Power.

The name of Niagara Falls is world wide not only for its scenic properties, but also as being the seat of the largest electrical and hydraulic power developments known to-day. These up to the present are practically all on the United States side of the river, but those under way and projected on the Canadian side will, when completely developed, amount to a much greater total. There are at present three companies which have been granted franchises, the Canadian Niagara Power Company, the Ontario Power Company, and the Toronto and Niagara Power Company, all of which are now actively engaged on the work of getting their respective installations built and in order. The Canadian Niagara Power Company is adopting the same plant design as that used by the Niagara Falls Power Company on the New York side, namely, vertical generators and turbines, with a wheel pit and a tunnel tail race. The charter allows a total development of 100,000 horse power. The units will be 7,500 k.w. three phase, 12,000 volts, and are being manufactured by the General Electric Company. It will thus be seen that they are just twice the size of those across the river, and that they further differ in voltage and number of phases, the first installation being 3,750 k.w., 2,200 volts, and two phase. The capital interested in the two companies is virtually the same. The Ontario Power Company, on the other hand, are adopting a somewhat different plan, in that their power house will be down at the river bank, the water reaching it through steel penstocks and flumes. This means that the wheels and generators, the latter of which will be of Westinghouse manufacture, will both be horizontal. Their franchise allows a development not exceeding 150,000 horse power. The last company to enter the field, the Toronto and Niagara, is composed mainly of Toronto interests, who are also identified with the electric lighting and railway companies in that city. They will use the submerged wheel pit form of construction, similar to that of the Canadian Niagara Power Company, with a tunnel tail race emptying under the Horseshoe falls. The power house will be on the normal Park level, which means vertical wheels and generators. The franchise allows a total installation of 125,000 horse power. The units will be about 8,000 k.w. three phase, 12,000 volts, and will be of General Electric design. It will be seen from the foregoing that, when everything on the Canadian side has been developed to the limits of the present charters, there will be some 375,000 horse power available. The capacity which the Niagara Falls Power Company, the largest on the American side, will have developed in the near future is but slightly over 100,000 horse power.

Single Phase Traction.

We print elsewhere in this issue a letter from the United States consul at Berlin, Germany, commenting upon a car equipped with an experimental set of single phase motors, and which, according to the information he gives, has proved an entire success. Another somewhat more detailed account has come to our notice, in which it is stated that the motor possesses a large air gap, notwithstanding which the power factor is extremely good, that it has an extremely large starting torque, behaving much as a series wound direct current machine, and that speed regulation is accomplished without the use of rheostats. If the claims made for the apparatus are borne out by experience the designers and builders have at last solved a problem which has been worked on for many years by several of the most eminent electrical firms, both on this continent and in Europe.

The main advantage of an alternating current motor is that it allows the transmission of power at a high potential, possible only with alternating current generators, owing to the absence of commutators, and the consequent decrease in the cost of copper, and uses that power without the necessity of installing revolving apparatus, such as the rotary converter or motor generator set. These equipments, necessary adjuncts of an alternating transmission and direct current motors, are not only costly to install but annually require a large outlay for maintenance and operation. It may, of course, be necessary in an alternating current motor system to install static transformers, depending on whether or no the motors can be wound to receive the line potential direct, but even if necessary they are much less costly than rotary apparatus, and require but a fraction of the attention. Another most desirable feature of the alternating motor is the elimination of the commutator, a most fertile source of repair bills, besides limiting the potential at which motors can be successfully operated, of at any rate the direct current type, to about 600 volts, which is practically universal practice to-day.

The main point which has hitherto retarded the alternating motor in its application to traction work is that both the synchronous and induction types, multiphase or single phase, are essentially constant speed machines, like the direct current shunt wound motor. Thus they do not possess that great characteristic of the series direct current machine which makes it so eminently suitable for traction work, namely, varying field strength with varying loads, and the consequent large increase in torque for but a small increase in current. In fact, both single phase and multiphase synchronous and single phase induction motors are notoriously deficient in starting torque, a point in which the direct current series motor, as constructed to-day, excels. Further, traction work, which is a most exacting service, requires for mechanical reasons a machine with considerably more air gap than is usual in stationary alternating induction motor work. This means, unless otherwise compensated for, a most difficult problem, that there is going to be a considerable decrease in the power factor, with an accompanying increase in the heating and losses in all the apparatus concerned, generators, motors and transformers, besides which the line drops will be heavier.

On the other hand, the single phase series motor, equipped with a commutator similarly to direct current apparatus, possesses starting torque and other desirable characteristics to practically the same extent as the latter, while still allowing the elimination of the rotary converter equipment. It is true that the retaining of the commutator is far from being a desirable feature, but it is stated that, in the Westinghouse motor of this type, now being built for the Baltimore and Annapolis road, the commutation is fully equal to that of the best direct current apparatus on the market to-day. We are not informed as to the specific type of machine referred to in Mr. Mason's letter, but presumably, if a commutator has been employed, satisfactory means have been found to overcome sparking. In addition to the points mentioned in the foregoing, the single phase machine has the additional advantage over any of the multiphase types of requiring but one trolley wire, the rails being used as a return. This removes the difficulty of adjacent trolley wires with a high potential between them, and simplifies the problem of current collecting devices. Besides this, the wiring and controlling apparatus is somewhat more simple for single than for multiphase work.

It will thus be seen that a single phase railway motor, possessing the necessary characteristics, is a most desirable piece of apparatus, and one which will find awaiting it an enormous field, not only ready but anxious to be exploited.

MEETING OF THE ELECTRICAL SECTION.

The recently formed Montreal Electrical Section of the Canadian Society of Civil Engineers held an interesting meeting in their rooms on November 19th. Dr. R. B. Owens, President of the Section, was in the chair, and there were present about 125 members and others interested.

The first paper was read by Mr. Paul M. Lincoln, of Pittsburg, Pa., late electrical engineer for the Niagara Falls Power Company, the subject being a comparison between the application of A. C. and D. C. currents to electric railways, with special application to the single phase system used by the Westinghouse Electric & Manufacturing Company on the Washington, Baltimore & Annapolis Railway System.

The paper was very interesting, giving very complete date as to the relative costs both of installation and operation, and also a complete description of the method used and the apparatus needed in a single phase railway system.

The second paper was read by Mr. A. H. Armstrong, of Schenectady, N. Y., and was a comparison between the advantages of electricity and steam in the operation of trunk line railroads. The paper compiled in a very concise way by means of diagrams an amazing amount of data and showed very clearly what economy could be expected by the application of electricity to heavy train loads under various conditions.

Professor L. A. Herdt's paper having been printed, was taken as read, and was descriptive af some European railroads now employing, with more or less success, the alternating current.

The papers showed what an immense amount of time and thought had been given to the subject by the leading manufacturers of this country, and placed things in such a light as to show how important it is for new companies to consider carefully the advantages of the new systems and their successes already achieved, before deciding on how their roads will be equipped. The discussion was interesting and general. Many questions of interest were asked and answered; and the general feeling of the meeting seemed to be that the evening had been a profitable one, especially as throwing considerable light on some of the most important questions of the day.

For subsequent meetings papers on the following subjects are promised : January 7, "The Relative Cost of Producing Power by Steam and by Water under Different Conditions;" February 11, "Recent Developments in Electric Illumination;" March 18, The Use of Electricity on Canals;" April 17, Power Station Design and Operation as Affected by Recent Adances in the Design of Turbo-Electric Machinery." Mr. W. A. Duff, of the Canadian Westinghouse Company, is secretary of the Electrical Section.

IMPROVEMENTS TO STREET RAILWAY PLANT.

The Toronto Street Railway Company are making some important improvements and additions to their power house for the purpose of providing increased power. They have recently installed two new Babcock and Wilcox boilers of a rated capacity of 520 h.p. each working under a steam pressure of 160 pounds. Two more boilers of same type and capacity are now being installed, and arrangements have been made to install four more without delay. When the proposed additions to the boiler plant are completed the company will have a total boiler capacity of 9,860 horse power, capable of carrying an overload of fifty per cent. The company are also installing two Laurie cross-compound horizontal Corliss engines of 1,600 h. p. each, direct connected to two 850 k.w. C.G.E. generators. They are remodelling the switchboard and spending about $80,000 on new feed wires.

In a new building 70x130 feet a storage battery plant to help out during the hours of heavy traffic is being installed. It consists of 276 cells, of the Chloride Accumulator type, of 3,000 ampere hours capacity, and is being installed by the Canadian General Electric Company, Canadian representatives of the Electric Storage Battery Company, of Philadelphia. In the installation of this battery and other improvements in contemplation, the company hav in view the utilization of Niagara power upon the completion of the works of the Toronto-Niagara Power Company.

TORONTO ELECTRICAL ENGINEERS.

The Toronto branch of the American Institute of Electrical Engineers have held several interesting meetngs, at which papers were presented and discussed. On Friday evening, December 11th, Mr. James Kynoch, chief engineer of the Canadian General Electric Company, will deliver an address on the Soulanges Canal

The meetings are held in the Engineers' club rooms, 96 King Street West, on the second Friday in each month. The president of the Toronto branch is Mr. J. A. Kammerer and the secretary Mr. R. T. Mackeen.

ELECTRIC LIGHT INSPECTION.

The Inland Revenue Department of Canada have issued a report covering the inspection of electric light during the year ended June 30, 1903. The fees for the inspection of meters were $19,739.75, as compared with $16,373.75 for the preceding year. For registration of companies there was received $4,155, making a total revenue of $23,894.75. The expenses of inspection were $8,005.74. The sum of $1,939.05 was expended on standard instruments, leaving a net revenue of $13,454.96. It will thus be seen that notwithstanding the reduction in the annual registration fees which was made on July 1, 1902, the service is self-sustaining.

There were presented for inspection 16,085 meters, 15,933 of which were accepted as coming within the error tolerated by law ; 124 were rejected, and 28 were verified after first rejection. The details follow :

DISTRICTS.	Number Presented.	Verified as coming within the error tolerated by law.			Rejected.			Verified after First Rejection.		
		Co rect.	Fast.	Slow.	Unsound.	Fast.	Slow.	Correct.	Fast.	Slow.
Belleville	341	151	83	107	...	...	...	...	...	
Hamilton	663	229	200	234	...		...	...		.
London	808	246	241	312	...	1	...	...	1	7
Ottawa	3,854	223	428	3,155	15	1	2	...	...	.
Toronto	1,943	432	729	735	...	16	31	...	...	...
Montreal	3,678	2,219	1,018	400	1	21	3	3	13	
Quebec	969	306	610	53	...	...	...			...
Sherbrooke	148	44	36	63	.	.	5	...	...	...
St. Hyacinthe	212	211	....	.....	1		...	.	.	...
Three Rivers	60	25	13	22	...	..	..		.	..
St. John	673	243	1 8	249		3	.	.	...	...
Halifax	727	568	75	57	1	17	5	4	...	...
Charlottetown	86	19	25	41	...	1		.		.
Winnipeg	633	333	75	225	...	...	...	.	...	...
Vancouver	1,105	89	16	1,000	...		...	...	...	
Victoria	185	60	45	80	...	...	...	.	.	...
Totals	16,085	5,398	3,772	6,762	18	60	46	7	14	7

There were registered under the Electric Light Inspection Act during the year 324 companies, an increase of 9 companies over the previous year. Estimating that one arc lamp is equal to ten incandescents, there were in use on June 30, 1903, the inquivalent to 1,350,283 incandescents, an increase over the previous year of 236,487 incandescents.

SOME INTERESTING TESTS.

At the up-town plant of the McClary Manufacturing Company, London, Ont., some interesting tests are being conducted by Mr. R. J. Parke, of Toronto, to ascertain whether the wast heat from the enamelling ovens can be utilized to generate steam to operate the factory. The temperature of escaping gases is about 2,000 degrees Fahrenheit, and it is believed that it will be found possible to employ the waste energy for the purpose stated. Should the results of the tests prove satisfactory, the necessary boilers will be installed.

In this connection it may be stated that the McClary Manufacturing Company have just completed the erection of new works costing $250,000, with an independent electric power plant which cost $35,000. The location is on the Thames river, about one and one-half miles east of the main works in the city of London. The electric plant was designed and installed under the supervision of Mr. Parke, and it is claimed that the power house as a whole is one of the most modern and complete independent stations in Canada. In a later issue it is hoped to present a full description.

AGETYLENE GAS EXPLOSIONS.

Two explosions of acetylene gas machines, with serious results, occurred during the past month. By the explosion at the Lozar House, Ridgetown, Ont., one person was killed, while the second explosion, at Kippen, Ont., destroyed St. Andrew's church and injured five persons. It is feared that the pastor, Rev. Mr. McLennan, may lose his sight. The fine new brick edifice was rent and torn as if by an earthquake. The floor bulged up and the walls collapsed. The congregation was enjoying a social and the disaster came without warning. During the supper an odor of escaping gas was detected a moment before the explosion. The pastor and caretaker rushed to the cellar to shut off the gas supply and were just approaching the generator when the gas was ignited. It is not known definitely whether the explosion was due to the carelessness and negligence of those having charge of the machine or whether it was purely accidental.

The Queen's Hotel at Pilot Mound, Man., was on November 30th destroyed by fire, said to have been caused by the gas machine blowing up. A fourth explosion occurred in an hotel at Cornwall, Ont., but fortunately without serious results.

SPARKS.

Good advertising is the path finder for all who seek success in business.

"Wire for us and we will wire for you" is the latest bulletin board catch phrase used by a New York electrical fixture man.

A branch office of the Provincial Boiler Inspectors Department has been opened in Vancouver, B. C., with Mr. George O. Madigan in charge.

The by-law authorizing the purchase of the electric light plant by the town of Wingham, Ont., from Mr. Walter Green, for the sum of $28,000, was carried by a large majority on November 10th.

A dispatch from Chatham, N. B., under date of November 9th, said : "During a heavy snowstorm yesterday the snow pressed down the electric light wires on the telephone wires and the whole telephone system was put out."

Ironsides, Rennie & Campbell, contractors for the tunnel for the Vancouver Power Company between Lakes Beautiful and Coquitlam, B. C., have just purchased six powerful drills, known as the Rand Giant and having cylinder diameters of 3 5-8 inches. These drills are operated by an air compressing plant.

The city council of Stratford, Ont., has signed an agreement with the Stratford Railway Company. The company are given a fifty year franchise, exemption from taxation for twenty years, and the right to furnish light and power. Running rights are to be granted to other radial railways in the city, and the city service is to be completed and in operation by December 31st, 1904.

The new factory of the Shewin-Williams Paint Company, in Montreal, is to be operated by electric power, for which purpose two Westinghouse alternating current generators of 75 and 125 kilowatt capacity respectively will be installed in a separate power house 103 x 172 feet. There will be two Corliss engines of 130 and 200 horse power.

QUESTIONS AND ANSWERS

1. When paralleling two generators, one carrying a lighting load and the other induction motors, we understand that the combined load will have a different power factor from either of the others. Will you please tell us whether this power factor is higher or lower than the others, also will it be the same on both generators?

Ans.—The resultant power factor obtained from the combination or parelling of two circuits of different power factors will be intermediate between the two, that is, higher than the lower and lower than the higher one. How much it will differ from each, of course, depends on their respective values, and also on the relative amounts of energy in the two circuits. The power factors of the loads on the two generators depend upon the field excitations and the driving powers, they may be the same or they may be different, according to the adjustments made by the attendant.

2. Will you send explanations of the following terms either by letter or through your paper: (a) "Three-phase" as applied to machines, distingushing between three-phase and two-phase. (b) Also what is the difference between a three-phase and a six-phase machine? (c) Again, what does S.K.C. stand for as applied to machines and transformers? (d) How does a booster raise the voltage on a line? (e) Suggest a means of using a 110 volt D.C. generator (used for lighting purposes) to do electro-plating. (f) Will you please give a table showing the average weight per 1,000 feet of rubber covered and weather-proof wires? I have tables of the weight of cotton-covered wires but not for those above mentioned.

Ans.—(a) A single phase alternator is one which has but one winding, and thus generates but one voltage. This, starting from zero, rises in a certain direction to a maximum, then decreases to zero, then rises again, but in the opposite direction, and finally falls to the original zero point. The complete round or series of operations is called a cycle. Now, if two of these machines were mechanically coupled together so that the maximum voltage of one was generated just a quarter of a cycle after that of the other, the two potentials would be in what is called two phase relation. Similarly, if three machines were rigidly joined so that their three E. M. F.'s attained their maximums each one-third cycle behind the one preceeding it, their voltage would have what is called a three phase relation to each other. But it is unnecessary to have two or three separate machines, as the case may be, as the relative position of two or more E. M. F.'s can be maintained by placing the two or three windings in one frame, they being spaced so as to produce the phase relations desired. Such a machine is then a two phase or three phase generator, according to the method of winding employed, and is obviously cheaper and less complicated than separate units. Besides uniting the frames, it is found that it is also practicable to unite the various leads and so the six leads from three single phasers are joined to make three leads for a three phaser. It is also practicable to unite two of the four wires which would come from two single phasers, and thus they also are sometimes operated with three leads only. (b) Similarly to the above, a six phase machine is one giving six potentials, each one-sixth of a cycle behind the other. It is a system employed practically only with rotary converters, and even then the generating system is either two or three phase, being turned into six phase by means of static transformers. (c) The letters "S. K. C." are the distinguishing device or trade mark used by the Stanley Electrical Mfg. Company to distinguish its product from the various other goods on the market. They are the first letters in the names of three of that company's well known engineers, men who practically organized it, namely, Messrs. Stanley, Kelley and Chesney. (d) By being connected in series with one side of the circuit to be boosted, so that its potential is added to that of the main generator or transformer. (e) The method to be adopted depends very much on the articles to be plated. You can use a rheostat in series with the bath to keep the current within the required limits; if you have two or more baths taking the same amount of current they can be run in series, which will tend to reduce the rheostatic capacity required. Again, you might run the armature at a slow speed, and connect the fields in parallel if there is more than one field coil, or, if the articles to be plated are small you can run the machine at normal voltage and use a few incandescent lamps as a rheostat. (f) The following are average weights per 1,000 feet of the more common sizes of wires. For a complete list write any manufacturer.

Gauge.	Standard Weatherproof.	Slow Burning Weatherproof	Rubber Covered.
No. 4	145	180	180
6	95	130	130
8	65	85	90
10	40	60	55
12	28	40	40
14	18	33	30

4. Can an induction motor be used as a generator, or are they ever run that way?

Ans.—An induction motor can be used as a generator if excited by some other alternating current circuit, which may or may not be of the same frequency as that for which the motor is built. It cannot be excited from a direct current circuit, nor will it excite itself. This method of operation is not by any means a standard one, though it is sometimes used in case of necessity. If it is desired to provide emergency generator capacity, to be used normally as motors but installed so that they can be coupled up if necessary to some prime mover, the synchronous type is selected. Machines of this form with exciter and switchboard are perfectly self-contained and can be used with perfect satisfaction as either generators or motors, whereas the operation of the induction type, as advised above, requires some other alternating circuit for excitation, which is not always available in emergencies.

4. Is not an induction motor a constant speed machine, the same as a synchronous motor?

Ans.—Both synchronous and induction motors are often spoken of as being constant speed machines, compared with direct current apparatus, merely to indicate that they cannot attain any abnormal speed or run away, as is possible with shunt wound in direct current machines if the field gets weakened, or with the series wound type if the load gets too light. The synchronous motor makes absolutely the same number of revolutions, in any given period, as that made by the generator running it, providing they have the same number of poles. If not, the products of the number of poles and the number of revolutions of the two machines will be absolutely the same, and so, as long as the generator speed is kept constant, that of the synchronous motor will be absolutely constant also. On the other hand, the induction motor runs on the average from 1 to 4 per cent. slower than synchronism, depending on the size, design and load. That is, like the shunt wound direct current motor, it slows down slightly as the load gets greater, and speeds up if it be decreased.

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5. What is the size of the engine required to drive a given size of dynamo?

ANS.—We do not exactly understand your question. If you want to know the cylinder sizes we would advise you that it is impossible to give them without first knowing the size of the dynamo. If you want the relation between the power of the two machines you will find that as a general rule an engine of 1½ times the horse power of the dynamo rating in kilowatts will be satisfactory, that is, a 60 k.w. generator will take a 90 h. p. engine to drive it. This is true only for direct connected units. For belted machines you will require an engine approximately 10 per cent. larger.

IMPORTANT STEP IN ELECTRIC TRACTION.

Mr. Frank H. Mason, U. S. Consul at Berlin, Germany, writes under date of August 27 as follows:

"A practical experiment of the highest importance and interest in the development of electrical railway service is now in progress on a suburban line between Niederschonweide and Spindlersfelde, in the southeastern quarter of Berlin. During the past week there has been in daily operation a car driven by a new motor, invented by a young Austrian electrician and built from his plans by the Union Electric Company, of Berlin. This motor achieves with apparently entire success what has not been accomplished hitherto—at least not in Europe—viz., it propels the full-sized service car at any desirable degree of speed without employing any cumbrous and expensive regulating devices, while deriving its energy from a single-phase alternating current of 6,000 volts, carried along the line on one small trolley wire and delivered directly to the motor without conversion to a lower voltage or a continuous current.

The far-reaching importance of this demonstration—which will be at once recognized by every electrical engineer—will be apparent when it is remembered that electric traction, which has proven so effective and economical for interurban and suburban service, has met hitherto some very serious economic difficulties when applied to long distances. The method heretofore employed has been to send over the line alternating currents of high pressure which are taken off at intervals by sub-stations equipped with step-down converters that reduce it to a continuous current of low voltage, which is fed into the trolley wire or third rail and thus transmitted to the motors of passing trains. As already noted, this works very well for short lines such as are required in city and suburban transit and which are thronged with constant traffic. But when the proposition is to extend the same practice to a standard railway, connecting two cities from 100 to 300 miles apart, the cost of the installation and working expenses become practically prohibitive. Besides the frequent substations equipped with transformers capable of converting the high-voltage alternating current into a low-pressure continuous one, there is the question of heavy copper conductors throughout the line, and this, added to the fact that the transformers and rotary converters must stand idle except when the converted current is taken off and used by some passing train, has hitherto rendered the proposition economically untenable.

When the high-speed experiments were tried last year on the Government railway line between Marienfelde and Zossen, an alternating three-phase current of 10,000 to 12,000 volts was carried along the line on three copper wires and conducted thence by trolleys to transformers carried under the floor of the car, whence it was transformed to 1,150 to 1,800 volts and passed into the three-phase induction motors. The car, as will be remembered, easily attained a speed of 140 to 150 kilometers an hour, at which pace the rails began to give way. The further experiments had to be postponed until a more solid and substantial track could be provided.

The present experiment has therefore a wholly different purpose. It involves no question of extreme high speed, but rather the transmission of a single-phase alternating current at a voltage (6,000 volts in this case) sufficient to carry it over a long line on a small and relatively inexpensive wire, and the direct use of the current, without transformation, by a motor capable of running economically at any desirable speed and which fulfills all the other requirements of electric traction. The point demonstrated by the tests now in progress is the effectiveness of the new motor for the special purposes to which it is applied. No sparking or other technical difficulty appears thus far to shadow the success of the experiments. The system eliminates the expensive substations, with their heavy initial outlay and operating expenses, and is so simple and direct in its working that it may, at least in theory, be applied to lines several hundred miles in length. If the distances are very great, of course the power may be transmitted from a distant waterfall or steam plant at any desired pressure—say, 20,000 or 50,000 volts—and then reduced in ordinary transformers, requiring no especial care, to the working-line voltage of, say, 6,000 or more. The present tests are over a line of 3 or 4 miles in extent, the length being immaterial. There may be encountered new technical difficulties when this distance is increased to as many hundred miles, but such difficulties are only such as may be met in any long-distance transmission and such as electrical science at its present stage is fully prepared to overcome. The new motor is believed to have bridged the chasm and opened the way to economical, and therefore practical, long-distance electric traction on railways of standard capacity.

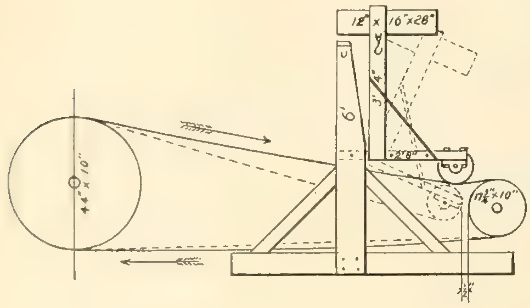
The Alpha Electric Company, manufacturers of electrical supplies, Montreal, is reported to have sold out to the R. E. T. Pringle Company, Limited.

Steps are being taken by the Dominion Rifle Association to introduce electrical power for the movement of targets at the Rockliffe ranges near Ottawa. Col. Tilton is working on a scheme by which it will be possible for the marker by simply pressing a button to raise and lower the target.

AUTOMATIC BELT TIGHTENER.

A correspondent of Power says: I am now using a tightener arranged in the manner shown by the sketch, which I believe is doing all that could be reasonably expected of a belt of this size. The belt is a 10-inch four-ply rubber belt, 49 feet 10 inches long, running off a 44-inch driver onto a 17¾-inch driving pulley. It drives a 54-inch rotary saw, 625 revolutions, cutting Alaska red spruce. Frequently the saw is buried the whole cut without the least sign of slipping of the belt. When the saw is out of the cut, the weight that the tightener applies to the belt is about 20 pounds. When the duty required brings the top and bottom sides within 4½ inches of each other under the tightener pulley, the weight applied to the belt by the tightener equals about 130 pounds.

Of course, the length of the tightener frame, the standard that carries the weighted box, and the weight placed in the box, governs the proportion of weight placed on the belt at different points. I find it is useless to overload with weight, and very often belts are too tight. I place my belt loose enough to give 4 to 5 inches sag in 10 to 12 feet to center, or, in other words, 5 inches sag to a belt when the centers of the two shafts are 24 feet apart.



Automatic Belt Tightener.

I have seen tighteners placed on or under a belt, then a lever used to pry up and block up until the belt would almost ring if hit. Such tension takes the spring and life out of a belt, and its only friend is the belt manufacturer; it never gives a belt a rest. Place your belt tightener right, run your belt loosely, and you will get lots of work and a long life. Give your belt a rest whenever you can; it needs it.

This form of tightener may be placed on horizontal, vertical, or belts at any angle, and if properly proportioned and properly loaded will surely give satisfaction every time. Construct your tightener frame so that if the belt doesn't run squarely on the pulley the frame can be moved slightly one way or the other, and the belt will run true.

There are right and wrong ways to run a tightener on a belt. For instance, take the tightener shown and turn it around, and the first time it goes down it will be very liable to break something—that is, if it is fastened properly. By placing the tightener about 4 inches from the driven pulley and having belt slack so there will be about 5 inches sag in the center of the belt in, say, 10 to 12 feet, when the strain comes on the belt the tightener drops, as shown by the dotted lines. This gives a greater percentage of belt grip on the pulley just at the time it is required, and when the load is thrown off the tightener is at once brought back and the strain released.

NEW SYSTEM FOR TRANSMITTING ELECTRICITY.

Mr. Oliver J. D. Hughes, U. S. Consul-General at Coburg, Germany, writes that a new system invented by two Alsatians for the transmission of electrical impulses without wires through the earth consists in both poles of an electric-current conductor being connected to the earth, whereby an electrical induction field is set up around each pole, the extent of which depends on the intensity of the current employed. In each of these two induction fields it is possible to utilize the electrical impulses produced at the place of generation by the introduction of two poles at suitable points within one of these fields. Relays, such as are well known in telegraphy and telephony, may be employed in order to transmit the electrical impulses over a wider area, these being connected to the two poles and their resulting currents being used to generate further fields. The inventors claim to transmit by means of their system telegraphic, telephonic, or any other desired electrical impulses, the transmission not being subject to outside influences, such as bad weather, storms, etc., factors which render the wireless transmission of electrical impulses through the air more or less unreliable.

ELECTRIC LIGHTING OF THE WELLAND CANAL.

The work of installing the arc lighting equipment for the Welland Canal is now under way. The new canal is 28 miles long and it is proposed to place a 2,000 c.p. a.c. enclosed arc lamp every 500 feet along the canal, with six lamps at each lock. The appropriation for this work by the Department of Railways and Canals for the current year is $100,000. The contract for the erection of the necessary poles has been given to Mr. Joseph Battle, of Thorold, and tenders will shortly be called for the electrical supplies, including arc lamps, transformers and transmission line material, and for the construction of the line and terminal station. The terminal station will be located at Thorold. It is proposed to install three-phase circuits for distributing the current to the motors for operating the lock gates, weirs, bridges and yard shops. The Lincoln Electric Light & Power Company, of St. Catharines, have been given a ten-year contract to furnish the electrical energy, which will be transmitted from the Decew Falls power station of the Cataract Power, Light & Traction Company. The plans for the complete equipment for lighting the canal were prepared by Roderick J. Parke, E. E., of Toronto.

A party of eastern capitalists have bonded all the Crown granted land from Cape Beale to Saritas Bay, on the south shore of Barklay Sound, British Columbia. The intention is to erect saw and pulp mills and to construct a tram railroad, to be operated by electricity, from Saritas to Duncans.

The Electro Manganese Company was incorporated some time ago under the laws of New Brunswick for the purpose of operating in Canada and treating the manganese as found by an electrical process. The company has established works at Shawinigan Falls, Que., and commenced operations a few days ago. The ore used is obtained from the Lower Provinces. Hitherto this material has been manufactured in blast furnaces from ore found in conjunction with rock, but an electrical process has now been perfected whereby bog ores, which are found in certain parts of Canada and which are high in manganese, can be successfully treated and a high grade of ferro manganese obtained. This material, which resembles bronze in appearance, is turned out in the form of pigs and is used by all manufacturers of steel rails. The company obtains its electrical power from the Shawinigan Water & Power Company.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, December 1st, 1903.

The Montreal Street Railway Company have been prohibited from running over street crossings in the suburb of Westmount at a greater speed than four miles per hour. Although ten mile speed is allowed between streets,the intersections are so frequent that the average speed obtainable is only five miles per hour. This is totally inadequate, as Westmount is from two and one-half to four miles from the centre of the city of Montreal. Westmount has only of late years been made a town, and its ambitious council are "feeling their oats" and stringing out by-laws, some of them to the great detriment of its inhabitants, the street railway speed control being one of such in question. Surely it would have been quite sufficient to have imposed "city speed" and cautioned against school streets to safeguard children coming to and from school at certain hours. Nevertheless, it ill becomes the management of the Montreal Street Railway to allow their motormen to open the front door and grin at the passengers the moment city limits are passed—ditto, the conductor. It should be remembered that the general public of the suburb are not in sympathy with the idiosyncrasies of the town council, and are entitled to respect in service rendered, be it slow or fast.

The Question Box at the last convention of the Canadian Electrical Association did not seem to elicit much information on the Nernst lamp. The circuits in Montreal are at 60 cycles, and motors of two or three-phase type are connected on quite a few. The single glower 110 volt Nernst has not been a signal success on such for some reason or other, possibly affected by motors? As we are all A. C. here someone's practical experience with them through the columns of the ELECTRICAL NEWS would be welcomed.

The Hewitt Mercury Vapor Lamp is beginning to be seen around New York stores. As it does not work on A. C. Toronto will have to tell us all about it. They are said to be on the market for 110 and 220 volt D. C.

The Eugene F. Phillips Electrical Works, of Montreal, have decided to construct a new factory in the town of St. Louis, the site for which, 100,000 square feet, was recently purchased. The municipal council has granted exemption from taxation for thirty years. The factory is to be completed by January 1, 1905, and the company undertakes to employ a hundred hands and to pay $35,000 a year in wages.

PERSONAL.

Mr. Duncan McDonald, assistant manager of the Montreal Street Railway, returned a fortnight ago from Paris, where he had been for some weeks on private business.

Mr. F. E. Hamilton, electrician, of Tottenham, Ont., has secured the position of superintendent of interior wiring, meters, and motors for the Berlin Electric Light Company, Berlin, Ont.

Mr. James Crosby has been appointed manager of the Halifax Electric Tramway Company, is succession to Mr. Frederick A. Huntress, who has accepted the position of manager of the Worcester Consolidated Railway.

Mr. Alex. Kennedy, a member of the well-known firm of William Kennedy & Sons, Limited, Owen Sound, Ont., dropped dead from heart failure on November 16th while superintending the erection of an elevator. He was 65 years of age.

Readers of the ELECTRICAL NEWS will regret to learn of the illness of Mr. T. C. Frenyear, sales manager for the Canadian Westinghouse Company, who was recently stricken down with typhoid fever while on a business trip to Fort William. As we go to press it is learned that his condition is much improved and he is believed to be on the road to recovery.

Mr. Charles H. Hines has been appointed electrical engineer for the Canadian Pacific Railway, with headquarters at Montreal. The office has just been created. Reporting to Mr. E. A. Williams, the superintendent of rolling stock, his duties will include a general supervision over all electrical matters, including power and lighting circuits, generators, motors, arc and incandescent lamps, and other electrical machinery and apparatus. The company has now under way a very large electrical installation at the new car shops in the east end of the city of Montreal, and electricity as a motive power is coming into more general use all over the company's lines.

Mr. Roderick J. Parke, electrical engineer, of Toronto, returned recently from Calgary, Alberta, where he spent about ten days making a survey of the water power of the Kananaskis Falls. It is proposed to develop and transmit the power to Calgary, a distance of fifty-four miles. While on the trip Mr. Parke took occasion to visit the Pacific Coast and reports conditions in the electrical industry there to be exceedingly prosperous. Contracting firms are busy and complain of a scarcity of good wiremen. He also spent a few days in Winnipeg and was much impressed with the rapid growth of that city.

Mr. J. Black, of Toronto, who is retiring after 40 years' service as boiler inspector for the Grand Trunk Railway, was the guest of honor at a banquet given by the company in Webb's Parlors last month. On behalf of the railway, Mr. W. D. Robb, superintendent of motive power, announced that Mr. Black would be granted a life annuity, and the firemen showed their appreciation of Mr. Black's services by presenting him with a handsome gold watch, chain and locket. Representatives were present from the entire system from Chicago to Portland, numbering in all 110. Mr W. Kennedy,master mechanic, of Toronto, presided.

Mr. H. F. J. Porter, who has been associated with Westinghouse interests since the first of the year and has held the position of assistant manager of the Publishing Department, with offices in East Pittsburg and 10 Bridge street, New York, has been made second vice-president of the Nernst Lamp Company, of which enterprise Mr. George Westinghouse is president, with the duties of general manager and headquarters at Pittsburg. He assumed charge on December 1st. This appointment does not affect Mr. Porter's relations with the Publishing Department at the present time.

The Ontario Municipal Power Commission has appointed Mr. R. A. Ross, of the firm of Ross & Holgate, Montreal, as electrical expert and fifth member of the Commission. The other four members, who were named by the convention of the municipalities of Western Ontario, are Messrs. E. W. B Snider, of St. Jacob's; Adam Beck, M.P.P., of London; W. F. Cockshutt, of Brantford, and P. W. Ellis, of Toronto. Mr. Ross is no doubt well qualified to perform the services which will be required of him, as he has been associated with several important electrical transmission enterprises. It is understood that his duties will be those of a consulting engineer to all the hydraulic and electrical engineers who will be employed by the Commission to report upon the problem of obtaing power from Niagara.

SPARKS.

W. J. O'Leary & Company, of Montreal, are installing an electric light plant at Richibucto, N.B.

Messrs. Williams & Wilson, Montreal, Que., ordered from J.C. Wilson & Co., Glenora, Ont., a 38 inch vertical Little Giant turbine for the Ogilvie Milling Co.'s mill in that city.

The Winnipeg city council has decided to submit a by-law to the ratepayers to raise $1,000,000 to develop the Assiniboine water power and to establish a municipal gas plant.

The Sunbeam Incandescent Lamp Co., of St. Catharines, Ont. announce in their advertisement in this number that they are prepared to supply incandescent lamps of the highest grade,and of equal efficiency for high or low voltages.

Westinghouse gas engines are to be adopted in a new central station now under erection at Berlin, Ontatio. The initial installation will aggregate 460 horse-power, comprising three 13 x 14, three-cylinder, 125 horse-power, and one 11" x 12", three-cylinder, 85 horse-power vertical engine. These engines will operate on city illuminating gas of 650 B.T.U. calorific value, and drive direct-current generators for furnishing municipal lighting.

The Laurie Engine Company, of Montreal, have just supplied the St. John Street Railway Company with a horizontal cross-compound condensing Corliss engine, with cylinders 23 and 44 inches respectively. It is registered 900 horse power and will be directly connected to a 650 k. w. generator for street railway purposes. The fly wheel has a 16 inch face and a diameter of 18 feet and weighs 35 tons. Two other engines of 500 h. p. and 450 h. p. respectively are being furnished to the same company by the Robb Engineering Company, of Amherst, N. S., to be used for lighting purposes. These three engines will furnish more power than is at present developed, and the capacity of the plant will be nearly doubled when the new machinery is installed.

RAILWAY COMPOSITE TELEPHONE AND TELEGRAPH SYSTEM.

The Bell Telephone Company of Canada has recently equipped one of the C. P. R. telegraph lines between Montreal and Ottawa with railway composite telephone and telegraph apparatus, which allows telephone service to be added to grounded telegraph lines without interfering in any way with the telegraph service already carried on over such line. As the name implies, the system has been designed specially to meet the demands of railway companies for a service of this character applicable to terminal or way stations of lines ot the above character. The length of the telegraph line and the number of way stations with which this system can be successfully employed depend largely on the character of the telegraph lines. The size and the material of the line wire and the amount of wire in cable are the most important factors limiting the range of the system. In general, it may be stated that it is usually possible to operate successfully over an ordinary telegraph line one hundred miles in length having five intermediate stations.

GENERAL DESCRIPTION OF THE SYSTEM.

The general arrangement of the system is shown on the accompanying drawing. At each terminal of that portion of the line over which telephone messages are to be transmitted is placed a terminal differentiator, consisting of an impedence coil in series with the line wire and a condenser from the line wire to earth.

As the telegraph battery is placed outside this piece of apparatus the latter serves to graduate the rise and fall of the telegraph currents so that Morse signals will not interfere with the telephone service and so that inductive or other disturbances will not be transmitted to the telephones from portions of the line beyond the coils.

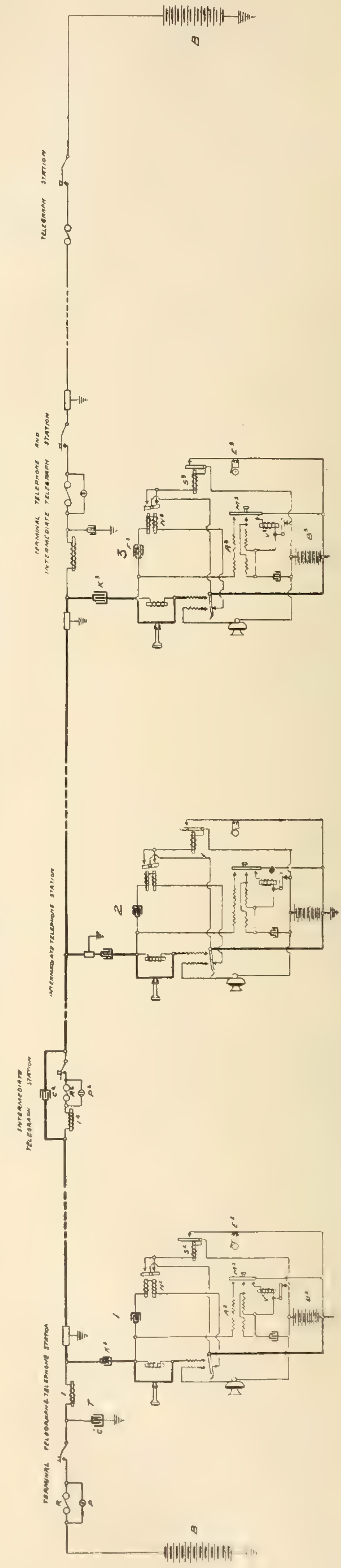
Each telegraph way-station is provided with an intermediate differentiator, consisting of a condenser and impedance coil. The impedance coil is placed in series with the telegraph relay, and relay coil and key are shunted by the condenser.

This apparatus affords a by-pass through the condenser for the telephone talking and signalling currents. Were it not for this apparatus the talking currents would be seriously reduced by the impedance of the relays and the telephone signalling currents would cause the relays to "chatter" or give false signals.

In addition to the above precautions the relays are directly bridged by polarization cells. The latter offer such opposition to the passage of the direct telegraph currents that their presence does not in the least interfere with telegraphic signalling. At the same time, they serve as a shunt for any telephone signalling current that, passing through the impedance coil of the intermediate differentiator, would otherwise affect the relay.

Each telephone set is connected to the line through a condenser, thus avoiding interference with the telegraphic service.

The set, in addition to the transmitter, receiver and induction coil, contains for calling a special vibrator operated by a push-button; and for receiving calls, a direct current bell controlled by a slow-acting relay, which, in turn, is controlled by a biased, polarized relay. For signalling and talking, a battery of 5 or 7


TELEGRAPH STATION
TERMINAL TELEPHONE AND INTERMEDIATE TELEGRAPH STATION
3
INTERMEDIATE TELEPHONE STATION
2
INTERMEDIATE TELEGRAPH STATION
1
TERMINAL TELEGRAPH TELEPHONE STATION

RAILWAY COMPOSITE TELEPHONE AND TELEGRAPH CIRCUIT

Edison-Lalonde cells as found necessary is provided at each station.

SUB-STATION SET.

The station set is arranged to be mounted on the wall and is similar in general appearance to the standard magneto sub-station set. A special transmitter marked C. R. C. (Composite Railway Circuit) is employed with these sets. The receiver is of the standard type but is permanently shunted by a special impedance coil which is designed to divert from the receiver the traces of the telegraphic or other currents which otherwise would cause disturbing noises to be heard.

This impedance coil has a movable iron core which can be inserted into the coil, or removed from it, to a greater or less degree, thus widely varying the impedance and regulating the proportion of the current that is shunted around the receiver. The value of this impedance should be as high as is consistent with the necessary freedom from disturbing noise.

OPERATION OF RAILWAY COMPOSITE CIRCUITS.

The circuits used in the railway composite system are shown in the accompanying drawing. This drawing shows at the left a terminal telephone and telegraph station, next toward the right an intermediate telegraph station, next a telephone station which may or may not be associated with the preceding telegraph station, next a terminal and telegraph station, and beyond an isolated telegraph station. All telephone stations are connected between the line and earth.

At the extreme left hand terminal of the line is shown one of the telegraph batteries B, the telegraph relay R of the combined telegraph and telephone terminal station, the polarization cell P shunting and relay R, and the terminal differentiator T, consisting of impedance coil I and condenser C I. The telephone set at this combined station is connected to the line through condenser K2.

At this station B2 represents the local battery of 5 or 7 Edison-Lalonde cells. The transmitter, hookswitch, induction coil, receiver, and its shunting impedance are represented conventionally.

At V2 is a vibrator, operating through a coil, with a condenser placed around the vibrator contact, and the operation of the vibrator controlled by a key M2. This portion of the equipment provides the high frequency signalling current.

At N2 is a biased polarized relay, and at S2 a slow-acting relay, controlled by the former, and having connected to its own back-contact the direct current bell E2. This portion of the apparatus is for receiving incoming signals.

At the next station (an intermediate telegraph station) is shown an intermediate differentiator consisting of impedence coil I2 and condenser C2. The relay R2 is also shunted by the polarization cell P2.

The remaining stations so closely resemble those referred to above as to require no further description.

METHOD OF SIGNALLING.

To call a distant station, as for example, station 3 from station 1, the operator at station 1 depresses key M2, which causes the circuit of battery B2 to be closed through the vibrator V2, the operation of which produces an interrupted current in the split primary winding of coil A2 and consequently a similar induced current being transmitted through the condenser K2, along the line, through the condenser C2, of the intermediate differentiator to station 3, and beyond.

At station 3 this signalling current flows through condenser K3 and F3, and the polarized relay N3 to earth. This current causes the armature of relay N3 to vibrate, thus opening the circuit which previously existed from the battery B3 through the slow-acting S3 to earth. The armature of relay S3 falling back, closes the circuit of the direct current bell E3 which gives the signal.

The talking circuit is of the simplest character and requires no explanation.

DEPRECIATION OF TELEPHONE EQUIPMENT.

By Henley V. Bastien.

The following excellent paper on the above subject was recently read before the Kentucky Telephone Association at Paris, Ky. Mr. Bastien is a graduate from the electrical engineering and telephone departments of Perdue University:

DEPRECIATION.

Depreciation, and what is it? Depreciation is the lessening in value of a particular thing due to some change in its condition, or a change in its relation to other things. As applied ordinarily to telephony it refers to the lessening in value of a plant due to the decay of poles, wires, switchboards, etc. Some would have you to believe that there is a depreciation in the plant due to the rapid advancement in the science of telephony. While this was undoubtedly true a few years ago, now I believe that the time has come in which apparatus is so well perfected that no one need fear necessity of having to throw it into the scrap-heap before it has served out its natural life.

The object of this paper is to investigate the lasting qualities of the various materials and apparatus used in the construction of a modern telephone plant, and to determine the annual rate of depreciation of the parts and the whole due to the ravages of wear, tear and time; and to mention the importance of giving it due consideration in the financing of a plant.

The argument is advanced by some that by proper maintenance of a plant it can be kept in as good condition as when built. This, I think, is entirely unwarranted; a telephone plant, like all other human productions, will wear out. It is practically conceded by the best telephone engineers that the only business way to provide for this wearing away is to lay by each year a certain per cent. of the original cost of the plant to be used for rebuilding when found necessary. This depreciation fund may be placed in a bank, loaned out at interest or reinvested in the telephone business, if thereby it will pay more than the current rate of interest. If this latter method be followed, it will be necessary to borrow money for rebuilding the original plant. But this will be alright, for, during the time of operation, the plant should more than double in size—increased by compound interest so to speak—with only the original part of the plant to be rebuilt. So long as it is strictly borne in mind that there is a depreciation, and provision made to meet it, all will be well. But if that which should be reserved for depreciation be paid out in dividends while the plant is new, an unwarranted premium will be placed on the stock at this time, and an injustice and hardship on the stockholder when the time comes for rebuilding.

Happily though for the Independant movement, the greater number of the companies do, in one way or another, provide for depreciation, and they do it most abundantly. The percentage usually considered to be right varies between 8 and 12 per cent. A most pleasing extreme from the company that lays by nothing.

Aside from the necessity of providing for rebuilding, there i another reason why depreciation should be studied—it enables the engineer to build or maintain the plant from the most economical materials (service, original cost, maintenance and length of life being considered). He must not use cheap materials, labor or apparatus because they are cheap; neither is he justified in buying that which costs most with the expectation of it lasting longest, and giving the best service. But to do justice to the company, himself, and his profession, he should investigate, keep records and thoroughly familiarize himself with these things.

I would like to say here that the figures which I use have been decided upon after a great deal of correspondence and investigation, and are not agreeable by any means, representing the opinions, as near as I can ascertain, of men who are best informed on the subject.

A plant is divided into two general heads

I. Office and subscribers' equipment.

II. Outside construction.

1. The first division is divided into three classes :

a. Local battery.

b. Central battery.

c. Automatic.

Of these I shall discuss only the local battery and central battery. The automatic has not been in operation long enough for us to say anything regarding its lasting qualities.

(a) Local battery systems were entirely used by both Bell and Independent companies up to about 1897, local battery boards frequently giving continual service in the Bell exchanges for 10 to 12 years; phones being used even longer than this. When it is remembered that these old boards and phones were very inferior in design and construction, and were not kept repaired in the best manner, are we not justified in saying that modern local battery switchboards and phones, built by reliable firms, should last 20 years, if maintenance be properly looked after. This gives 5 per cent. depreciation.

(b.) In central battery systems there is a finer, neater mechanical arrangement that is accompanied by much less wear and tear than in the local battery, and consequently a longer life may be expected. It is thought that 25 years of service may be had of a first-class central battery equipment. Thus per cent. depreciation.

II. Outside construction is divided into two classes:

a. Underground.

b. Aerial.

In underground construction and especially conduits we have the most permanent part of the plant. Conduits built of vitrified clay or terra cotta and concrete, being removed from sun and rain, freezes and thaws, are almost as everlasting as the Pyramids themselves. A rate of two per cent. is charged off to underground conduits, though I see no reason why 1 per cent. would not suffice.

Underground cables: The great enemy of underground cables in the past has been electrolysis. But high insulation conduits and greater care in installation have about eliminated these difficulties. In the past, cables were frequently destroyed, wholely or in part, by high potential currents and lightning discharges. However, by the use of improved protectors these have ceased to be factors. We have practically nothing to go by in determining the life of a well protected cable except guess-work. In view of the fact that an old cable is worth considerable as junk when discarded, a rate of 2 per cent. has been decided upon.

(b.) Aerial construction: Poles. Cedar and chestnut poles are almost entirely used in this country. Cedar poles 24 to 30 inches circumferential butt measure last about 15 years. Poles 30 inches and upward last about 20 years. Corresponding size chestnut poles will last 10 and 15 years respectively. As the tendency is toward using poles of the larger size, these only will be considered. Thus 5 per cent. for cedar and 6⅔ per cent. for chestnut.

Creosoted poles. Creosoted pine poles erected 30 years ago in England are still in good condition and will apparently las some time yet. I am informed by a gentleman who began creoscting paving blocks 32 years ago, that the first blocks treated are still sound and good, apparently good for 32 years longer. He is of the opinion that creosoted timber can be depended upon for at least 35 years. A depreciation on poles and cross arms of 3 per cent.

Cross arms of first-class long leaf pine will last only about 12 years, 8⅓ per cent. depreciation. If arms painted every two or three years, they can be made to last as long as the best cedar poles. 5 per cent. depreciation.

To obtain the above figures, it is necessary that arms and poles be not unduly strained, a factor of safety of 10 being about right.

Pole hardware: Bolts, braces, screws, steps, strand, etc., will last as long as the poles on which they are placed, if well galvanized. According to the modern practice it is undesirable to use plain hardware of any kind.

Aerial cable: If aerial cable is well put up, not run through trees, and well protected from lightning and high potential currents, it will last about 20 or 25 years, 4 per cent. being ample for depreciation.

Copper wire: There is practically no depreciation in copper wire due to the elements. Cutting and splicing will eventually render it useless. Copper wire, as junk, will about half replace itself. 2 per cent. is charged for depreciation.

Iron wire: The life of iron wire varies considerably in different localities, 3 to 5 years being a fair average in smoky districts; while through the open country it will last as long as 13 to 15 years. Under favorable conditions, 7 per cent. is about right.

General summary:

I. A modern exchange with central battery equipment and a large percentage of underground construction, creosoted poles and cross arms, copper wire leads and first class maintenance should show no more than 2½ to 3 per cent. depreciation.

II. Toll lines of creosoted poles and arms, copper wire leads, and well guyed, will have a depreciation of about 3 per cent.

III. Medium and small exchanges, with untreated poles and arms and galvanized iron wire, cable where necessary—from 5 to 7 per cent.

IV. First class country lines, untreated poles and arms, galvanized wire, from 7 to 8 per cent.

In conclusion, let me say this: Build your plants well. Build them in that "logical way," like the deacon built "that wonderful one horse shay" and your maintenance bills will be small. Impress on your maintenance department that "a stitch in time saves nine." Then your depreciation will be a minimum.

SHORT CIRCUITS.

Samuel Gidney, of Mink Cove, N. S., has purchased the entire stock of the Westport & Digby Telephone Company.

It is reported that the Merchants Telephone Company, of Montreal, purpose seeking a franchise for the operation of a system in Ottawa.

Incorporation has been granted to the Stark Telephone, Light and Power System, manufacturers of electrical apparatus, Toronto, with a capital of $1,000,000.

A joint stock company has been formed at Grand Prairie, B.C., to equip and operate a telephone service connecting Kamloops, Grand Prairie, Armstrong and Vernon.

The New Brunswick Telephone Company and the Union Telephone Company have both completed the extension of their respective lines from St. John to Grand Falls, N. B.

The organization of the Canadian Telephone Company was completed last month and a deposit of $25,000 made with the Dominion Government. The company will have its headquarters in Ottawa, where it has applied for a civic franchise. The directors elected are as follows: Charles Robinson, Scranton, Pa., president; Robert Bickerdike, M.P., Montreal, 1st vice-president; F. G. Stegmaier, Wilkesbarre; W. McCreary, M. P., Winnipeg; Geo. Fowler, M. P., Sussex, N. B.; Frank J. Leonard, New York, manager; J. R. Means, Scranton, treasurer, and J. T. C. Thompson, Ottawa, secretary. The total capital of the new company is $1,000,000.

The annual meeting of the British Columbia Telephones, Limited, was held at Huddersfield, England, October 21st. The report stated that the expenditure for improvements and extensions during the year ended June 30, 1903, amounted to £7,334, and the purchase of the plant of the Columbia Telephone-Telegraph Company involved a further expenditure of £7,668. A new switchboard and new instruments for the Victoria exchange, now being installed, would cost $15,000, while the estimated cost of laying a cable between the mainland and Vancouver Island was £35,000. In view of these expenditures the directors decided to carry forward the whole of the balance standing to the credit of the profit and loss account.

A dispatch from St. Paul, Minn., states that Mr. O. C. Greene, superintendent of the Northern Pacific Telegraph System, and Mr. Dildine, assistant superintendent, recently performed the novel feat of telegraphing 560 miles without the aid of batteries. The electricity was taken from the atmosphere during the great electric disturbance which lasted twenty hours. Messrs. Greene and Dildine conducted some interesting experiments and accurately measured the atmospheric intensity. The greatest pressure measured at any one time was 800 volts. This was the maximum register of the voltmeter used. The greatest range shown was 370 degrees swinging from the negative to the positive polarity. Both millimeters and voltmeters were used in the experiments.

POSSIBILITIES OF THE INCANDESCENT LAMP.

By H. D. Burnett,
Superintendent Lamp Department Canadian General Electric Co.

Very few people appreciate the full possibilities of the incandescent electric lamp. There is no difficulty in getting from it, if one knows how, any quantity of light desired ; any division or distribution ; any degree of brilliancy or whiteness of light ; any degree of dullness or redness to suit such as find "the incandescent light too bright for their eyes ;" any length of life desired, although very long life is not economical at average cost of current, and accompanied, as it usually is, by great reduction in candle power, it is not desirable.

With the cost of electric light, at present average prices for current, about as cheap as gas or oil, and so unquestionably superior to gas and oil in healthfulness, convenience and cleanliness, what remains to be desired? Surely, if everyone could have the advice of a disinterested expert so that his particular requirements might be fully satisfied, no one would be without the incandescent lamp in this day when a lighting station is to be found in every town. It is for the purpose of calling attention to a few important points not generally understood that this is written.

While thousands of lamp users will testify to the great convenience and perfection of the incandescent lamp—compared with other illuminants—still there are those who, through ignorance of its possibilities, have objections to the particular kind of light that may be supplied to them. It is to the interest of the station manager to study every complaint. A satisfied customer is his best advertisement. The complaint most frequently made is the general one of unsatisfactory life. The cause of this in 75 per cent. of all cases is found to be that the voltage has been too high for the lamps, it may be for only a few minutes each day.

Hold a white paper behind the lamps, and if the glass is noticeably darkened after a total run of less than 50 hours you have a sure sign that the voltage has been too high for the lamps. It is probably at times, if not regularly, from 5 to 10 volts higher than that marked on the lamps. The darker the bulbs the more certain you can be that the lamps have been strained, provided they have been in use but a few weeks. 16 and 32 c. p. lamps of 3.5 watts per candle efficiency will stand an occasional increase of 2 or 3 volts above normal without serious harm, but 8 or 10 volts increase will very rapidly shorten the life of the lamps and, at the same time, greatly reduce the candle power due to the darkening of the bulb and deterioration of the filament.

It is of first importance then that the lamps be selected of a voltage suited to your circuit if you wish to have satisfied customers.

Note that it is not necessary to change the voltage in your station. Your regulation may be satisfactory, and yet you may be getting unsatisfactory light or dissatisfied customers simply because you do not supply lamps of a voltage best adapted to your circuits.

Because your plant was designed for 104 volts it does not follow that 104 volt lamps are best adapted to your present conditions and throughout your entire circuits.

Every lamp manufacturer makes a complete line of voltages to suit all conditions. Our standard voltages are 50, 52, 54, 96, 98, 100, 102, 104, 106, 107, 108, 110, 112, 114, 117, 120, 125. The lamps of any one voltage are exactly as good in every respect as lamps of any other voltage, while lamps of 104 and 110 volts, being more largely called for, cannot usually be so promptly supplied as lamps of other voltages. Some of the largest central stations are to-day using regularly such voltages as 106, 107, 108, and 114 volts, while a large number of smaller consumers are finding other voltages better suited to their circuits than 104 and 110.

Let us suppose that a customer is now using 104 volt, 16 c.p. lamps of 3.5 watts per candle, i.e., each lamp consuming about 56 watts.

If the life is unsatisfactory examine the voltage at his lamps, and if you find it to average about 106 volts, and never higher than 108 or 109, supply him with 106 v. lamps of same c.p. and efficiency. A 104 v., 16 c.p., 3.5 watt lamp when run at 106 volts will have a useful life of only three-quarters that of the 106 v. lamp of same c.p. and efficiency.

"If the light is poor" see if the voltage is not often 3 or 4 volts below that marked on the lamp. If 102 volts is nearer the average, supply 102 volt lamps or whatever other voltage is necessary to make the lamps give their full candle power. Running a 104 volt lamp at 102 volts reduces the candle power 12 per cent.

If the voltage is correct (104) and the customer wants more light than 16 candles, you can easily satisfy him without paying the extra price of higher c.p. lamps by giving him either 102 volt or 100 volt, 16 c.p. lamps.

A 102 volt, 16 c.p., 4 watt lamp, when run at 104 volts, will give 18 c.p. at an efficiency of about 3.8 watts per candle, and 45 per cent. longer life than the 104 v., 16 c.p., 3.5 watt lamp that he has been using.

A 100 v., 16 c.p., 4 watt lamp, when run at 104 volts, will give 20 c.p. (efficiency 3.6 watts per c.p.) and longer life than the 104 v., 16 c.p., 3.5 watt lamp. The same applies to a 106 v., 16 c.p., 4 watt lamp when run at 110 volts.

A 102 v., 16 c.p., 3.5 watt lamp, when run at 104 volts, will give 18 c.p., but the efficiency being about 3.3 watts per candle, the life will be about 25 per cent. shorter than the 104 v. 3.5 watt lamp on the same circuit.

When a lamp is run 2 per cent. above its normal voltage (for example, a 102 v. lamp run at 104 v.) it will take about 2 per cent. more current (amperes) than at normal voltage, and the watt consumption will increase about 4 per cent. The meter customer should be willing to pay for 4 per cent. more watts for he is getting 12 per cent. more light from the lamp. This applies to any lamp whatever the efficiency or candle power.

If the customer finds the 104 v., 16 c.p., 3.5 watt lamp "too bright or hard on the eyes," first try the frosted lamps, which disperse and subdue the direct light rays from the filament, and if that does not satisfy him give him 108, 110, or 112 volt lamps, frosted if desired.

A 112 v., 16 c.p., 3.5 watt lamp, when run at 104 volts will give about 10 c.p. at an efficiency of about 4.6 watts per candle, while the light will be much less bright or intense, and more red in color than the 104 v. lamp because of the change in efficiency. The above illustrations show the wonderful adaptability of the incandescent lamp to varied conditions and requirements.

Wide acquaintance with the actual conditions present in lighting plants leads to the conviction that over 90 per cent. of all installations in Canada to-day would find it to their very great advantage to use lamps of some other voltages than 104 or 110.

Note that by selecting lamps of the proper voltage very many stations now using 4 watt lamps (of too low voltage) could get just as long life and a more satisfactory light from 3.5 watt lamps, and thus add over 14 per cent. to the capacity of their plant without any additional expenditure for apparatus or wire.

The best efficiency for the average central station in Canada, with fairly good regulation, is 3.5 watts per per candle for sixteen and higher c. p. lamps. 4 watt lamps, formerly used extensively, are rapidly being superseded by the more efficient lamp, while some large central stations that were using a still higher efficiency (3.1 watts per candle) have recently adopted 3.5 watts per c. p. as being more satisfactory, all things considered.

It does not seem to be generally known that lamps of lower c.p. than 16 necessarily have filaments that are thinner and more fragile than the 16 c.p. filament. If, then, they are made of the same efficiency they must be shorter lived than the 16 c.p. lamps.

We therefore advise that where 16 and 32 c.p., 3.5 watt lamps are used that 8 and 10 c.p. lamps be about 4 watts per c.p., 5 c.p. lamps be about 4.5 watts per c. p., and 4 c.p. lamps be about 5 watts per c.p. These efficiencies, being our standard, are always kept in stock, and can be supplied more promptly than any other efficiencies.

A reliable portable voltmeter is an indispensable adjunct to every lighting station. This should be provided with an attachment plug for taking the voltage from the lamp socket. Such instruments should be checked occasionally with others, newly purchased or recently calibrated.

PUBLICATIONS.

The Woodward Governor Company, Rockford, Ill., have issued a new catalogue describing and illustrating their governors for water wheels. It contains much of interest to the hydraulic engineer.

We have been favored with a copy of a paper on "The Influence of Electricity on the Development of Water Powers," read before the New England Cotton Manufacturers' Association by Mr. F. A. C. Perrine, D.Sc., of Pittsfield, Mass.

The Standard Tool Company, Cleveland, Ohio, are among the largest manufacturers of twist drills and similar tools in the United States. Their catalogue, recently issued, is very complete and should be in the hands of all persons interested.

The Canadian General Electric Company, Toronto, have just issued Bulletin No. 830 referring to the Thomson high torque induction wattmeter. The efforts of this company have been directed towards the production of a meter which would not only be initially accurate under all reasonable variations of conditions, but which might be expected to remain accurate and retain its operative value through a long period of use.

"Notes on Electric Railway Economics and Preliminary Engineering," by W. C. Gotshall: This book is published by the McGraw Publishing Company, of New York, and is based upon a series of lectures which the author delivered at Lehigh University, the subject of which dealt with the economics of the preliminary and other determinations and the construction and operation of high speed and heavy traction interurban electric railroads. It is a valuable addition to electric railway literature.

NEW TELEPHONE LINE

A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates :

Port Rowan -	50c.
St. Williams - -	50c.
Vittoria - -	40c.

THE BELL TELEPHONE CO. OF CANADA

ANY NEW CUSTOMER

Who sends us an ORDER this month through this advertisement will be allowed an extra 10 per cent. Does it pay to advertise ?

THE HILL ELECTRIC SWITCH CO., LIMITED

426 ST. PAUL STREET, MONTREAL

THE THORNBURY GASOLINE ENGINE & FOUNDRY COMPANY. LIMITED.

The Thornbury Gasoline Engine & Foundry Company, Ltd, Thornbury, manufacturers of gasoline engines and other varieties of light machinery, have a fine two-storey brick fireproof building, 75x40 feet, situated in close proximity to the Grand Trunk Railway lines and overlooking the bay, which affords good shipping facilities.

Their motive power at present indirectly is steam and directly a gasoline engine of twelve horse-power. A much larger engine is in course of construction. The machines used are of the latest Canadian and American types.

The moulding room is very modern with a present capacity of nearly ten tons per day. The shareholders of the company, with J. H. Carmichael as president, are mostly mechanics, which is an assurance that work turned out will be satisfactory. While the company's daily output is large, they are not yet in complete operation, but expect to be early in December, at which time they will employ twenty men for a start. They are at present completing a large order for boiler gratings and other castings of this style.

The town council of Amherst, N. S., is negotiating for the purchase of the electric plant operated by the Canada Electric Company for the lighting of the streets of the town.

SPARKS.

The Bell Telephone Company are making alterations to the interior of their offices in Hamilton.

The town council of Essex, Ont., will submit a by-law to the ratepayers for the purchase of the electric light plant.

W. A. Smith is developing a water power at Renfrew, Ont. The electric power will be utilized for the operation of the grist mill and wood-working factory, the latter now under construction.

The Redpath Motor Vehicle Company, of Berlin, Ont., has been incorporated, to manufacture motor driven vehicles and gasoline engines. The promoters include Messrs. A. H. Reid and Walter Redpath, of Toronto.

Westinghouse, Church, Kerr & Company, who have undertaken the erection of new buildings at Hamilton for the Canadian Westinghouse Company, have taken out the necessary permit, which shows that the sum to be expended is $234,800.

The Telephone Committee of the Ottawa City Council have recommended that a twenty-one-year franchise be granted to the Canadian Telephone Company, the company to pay $2,500 a year, supply 40 telephones to the city free and furnish business phones at $36 and house phones at $22.

The Halifax Electric Tramway Company were defendants in the Supreme Court in an action for damages brought by the mother of a young man who was thrown from his carriage by collision with an electric car, on Sunday, April 20th, 1902, receiving injuries from which he died. One of the grounds in the action was that in operating the cars on Sunday the defendants were acting illegally, being guilty of performing servile labor. The case lasted several days, and resulted in a verdict for the defendant company on all the points raised.

The Montreal Street Railway Company recently made application to the city council for an extension of its franchise for thirty years. The company's present franchise has still nineteen years to run, and the company practically asked for a fifty year franchise, in return for which they agreed to sell ten instead of eight tickets during working hours for twenty-five cents, to water and sweep the streets on which the cars run, remove the snow from the tracks in winter and pave with granite blocks the unpaved track space on such streets as are now permanently paved. By a vote of 26 to 6 the company's offer was rejected

Electrician, 2[illegible], seeks situation, under large company preferred; five years' experience erecting and running of small light and power plants; repairs, electrical and mechanical. English and French. Apply J. STEER, Minnedosa, Manitoba.

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TRADE NOTES.

Mr. J.F. Burgoyne is fitting up the old mill at Croydon, Ont., replacing the old water wheel by a 28 inch Little Giant procured from J. C. Wilson & Company, Glenora, Ont.

Bulletin No. 20, just issued by the Hyatt Rolling Bearing Company, of Harrison, N. J., shows a number of applications which have been commercially made of Hyatt bearings for conditions involving heavy duty at slow speed. Copies of this bulletin may be had on application to the company.

Mr. W. J. Morrow,of Brown's Brae, Ont.,have recently placed an order with J. C. Wilson & Company, Glenora, Ont., for a 24 inch Little Giant turbine, gearing, shafting, etc., to be installed in a saw mill he is fitting up at that place.

The Packard Electric Company has recently supplied a complete equipment for series alternating arc lamps for the Lincoln Electric Light & Power Company, of St. Catharines, the equipment consisting of 80 Western Electric series alternating lamps, with switchboards and Packard type " R " transformers.

The Chapman Double Ball Bearing Co., of Canada, has secured a plant and are now installing in Toronto special machinery for the purpose of manufacturing line bearings and shafting which will be their specialty. Other lines will follow such as bearings for carriages, wagons, street-cars and trucks of all kinds.

We reported in our November number that the Brant Milling Company, Brantford, Ont., had placed an order with J.C.Wilson & Company, Glenora, Ont., for a 10 inch "Little Giant" turbine. We now learn that they have since ordered another, an 8 inch wheel with brass buckets, which will make the seventh "Little Giant" to be installed by them.

The tremendous demand which has been made upon the Packard Electric Company, of St. Catharines, for their "Packard" lamps has necessitated an increased capacity in their lamp department. Although the equipment of the plant has been doubled, it is only by working overtime that deliveries are kept up with the incoming orders.

The attention of electrical supply houses and jobbers is directed to the advertisement in this issue of The R. Thomas & Sons Co. This company is one of the largest in the world and make a "special drive" for high voltage work. They are pioneers in the electrical porcelain line, being continuously in the manufacture of porcelain insulators, knobs, cleat, tubes, etc., for over thirty-three years. Mention this paper and get their special price list.

SPARKS.

C. W. Ross, a dealer in electrical supplies at Quebec, assigned last month.

It is stated that the Hull Electric Company are considering the advisability of developing a water power and of installing an electric plant at Quyon, Que.

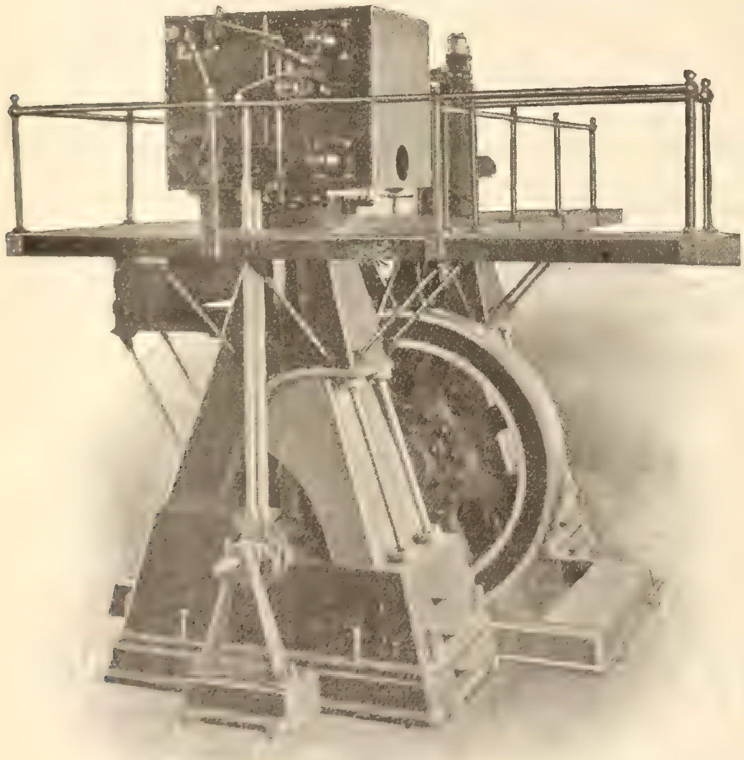
The village of Havelock, Ont., is considering a street lighting proposition, which, if adopted, will mean the payment of $62.50 for each of ten 2,000 c.p. lamps for a period of ten years.

Dr. F. A. C. Perrine, president of the Stanley Electric Manufacturing Company, delivered the Founder's Day address on November 30th last at the Thomas S. Clarkson Memorial School of Technology at Potsdam, N. Y.

President Myles, of the Hamilton, Grimsby and Beamsville Electric Railway, states that nothing definite has been decided with reference to the proposed extension of the line to St. Catharines. The new extension from Beamsville to Vineland has been put in operation.

Messrs. W. Moore & Sons are developing a water power about two miles north of Meaford, Ont. A dam about 700 feet in length is being built and it is expected to obtain 600 horse power. The plant will be completed about next midsummer.

THE LAURIE ENGINE COMPANY
MONTREAL, CANADA



Some Laurie Corliss Installations:

British Columbia Electric Ry. Co. - 2,100 H. P.
Winnipeg Electric Street Ry. Co. - - 2,200 H. P.
Toronto Electric Street Ry. Co. - - 1,500 H. P.
Montreal Street Railway Co. - - 11,500 H.P.
Dominion Iron & Steel Co. - - 2,400 H. P.
Cape Breton Electric Tramway Co. - 1,200 H. P.

LAURIE CORLISS ENGINES
UNAPPROACHED FOR ECONOMY, EFFICIENCY OR REGULATION

SPARKS.

Mr. T. T. Simpson, consulting engineer, of Ottawa, has been retained as expert on the case of Stone vs. The Ottawa Electric Company, a suit for damages arising from the death of George Stone, who was killed at the Ottawa Collegiate Institute on August 22nd last.

A syndicate of American and Canadian capitalists has commissioned Mr. T. T. Simpson, of Ottawa, to report on and prepare estimates for a long distance transmission plant to deliever from 10,000 to 20,000 h.p. to the city of Winnipeg. The transmission line will be over 100 miles long, and when completed it will be one of the largest transmission plants on this continent.

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Do not do business on catchy talking points only, the quality of our Babbitt Metal and Solder and the supremacy above other does it. Twenty-two years is our experience.

Our aim is the best, we have no competition if quality is considered.

Let us send you a sample order.

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1–50 K W. S.K.C. Generator, 2000–1000 volts, 8000 alternations, with 2½ K.W. Exciter and Station Apparatus complete.

1–5 H.P. S.K.C. Motor, 8000 Alts., 500 volts, with necessary Transformer 1000–2000–500.,

1–25 K.W. R. E. Co. Bi-Polar D. C. Dynamo, wound for 110 volts, with sliding base, pulley, brushes, etc, complete.

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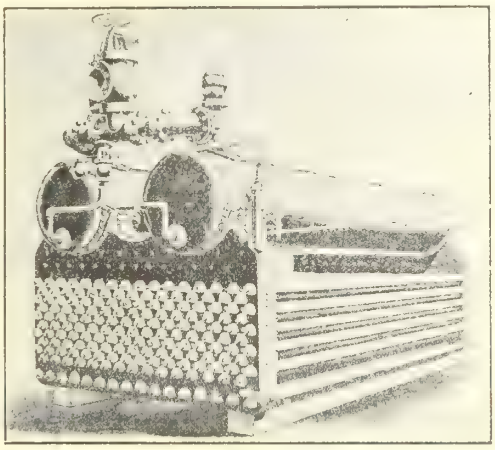

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SPARKS.

The firm of Bennett & Moncel, electricians, Montreal, has been dissolved.

The Allen Electric Company, of Brantford, Ont., are doing the electric work in new library building at Paris.

The E. S. Harrison Company, of Winnipeg, have been given the contract to rebuild the telephone systems at Moosomin and Wapella, N. W. T.

Contrary to the terms of the franchise their Cornwall (Ont.) Street Railway Company operated their cars to the railway depots on Sunday, November 29th, to accommodate some 250 Knights of Columbus who had come to Cornwall from surrounding points to organize a new council of the order. No other passengers were carried. The police warned the company against taking out their cars and the matter may be settled by the courts.

The ratepayers of Renfrew, Ont., last month defeated the by-law authorizing the town to raise by an issue of debentures the sum of $87,000 to purchase the plants and works of the Renfrew Power Company and the Renfrew Electric Light Company. The vote stood 57 for and 131 against the by-law.

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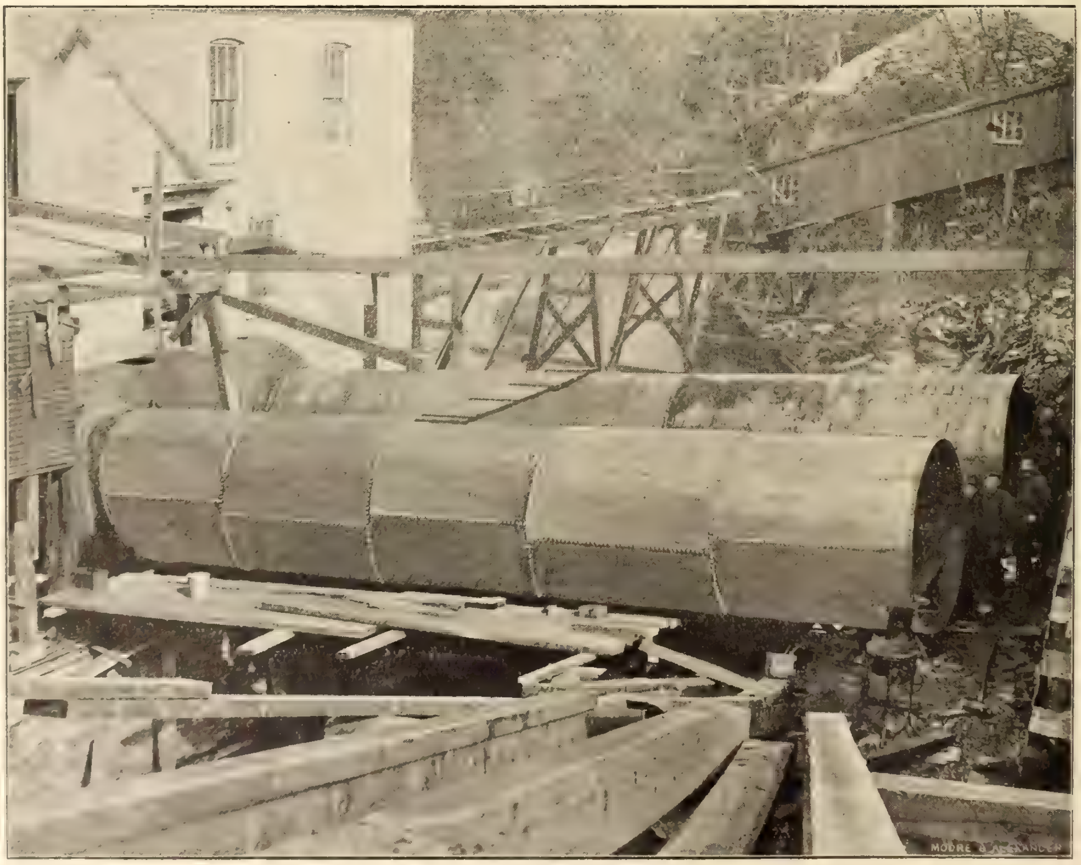

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J. C. Wilson & Company, Glenora, Ont., have just received export orders for three Little Giant turbines, a 33 inch, 21 inch and 10 inch, to be shipped to Great Britain.

The Sherbrooke Light, Heat & Power Company, of Sherbrooke, Que., have agreed to extend the light contract with the city from 1st July to 1st October, 1904, in accordance with a resolution passed by the city council.

A large electric light plant and the franchise of the Siemens Halske Company, of Berlin, in the city of Mexico, have been acquired by the Mexican Light, Heat & Power Company. This company have just installed a large plant for the transmission of electric energy and at present are engaged in perfecting plans for furnishing the city of Mexico and the mining districts of El Ora with light and power, for which purpose a large plant is being installed at Necaxa. The contract calls for six generators of 5,000 k. w. capacity each and six turbines of 8,200 horse power each. The officers of this company are: President, James Ross, Montreal; vice-presidents, E. S. Pearson, Halifax, and J. H. Plummer, Toronto. Senator George A. Cox and William Mackenzie are also interested. The consulting engineer is Mr. H.L. Cooper.

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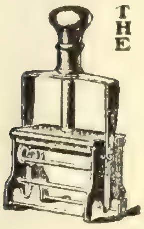

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SPARKS.

It has been announced that the Lake Ontario Steamship Company have decided to purchase a turbine steamer for the Toronto-Hamilton line. The steamer will be built by the Hawthorne-Leslie Company, Newcastle-on-Tyne.

The Rossland Power Company, Limited, of Rossland, B. C., has obtained approval of its scheme to generate power. The company has acquired records of 950 inches of water and the cost of the work is estimated at $100,000. The plant is to be completed by the end of 1905.

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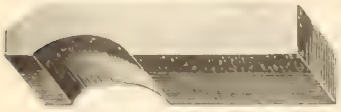

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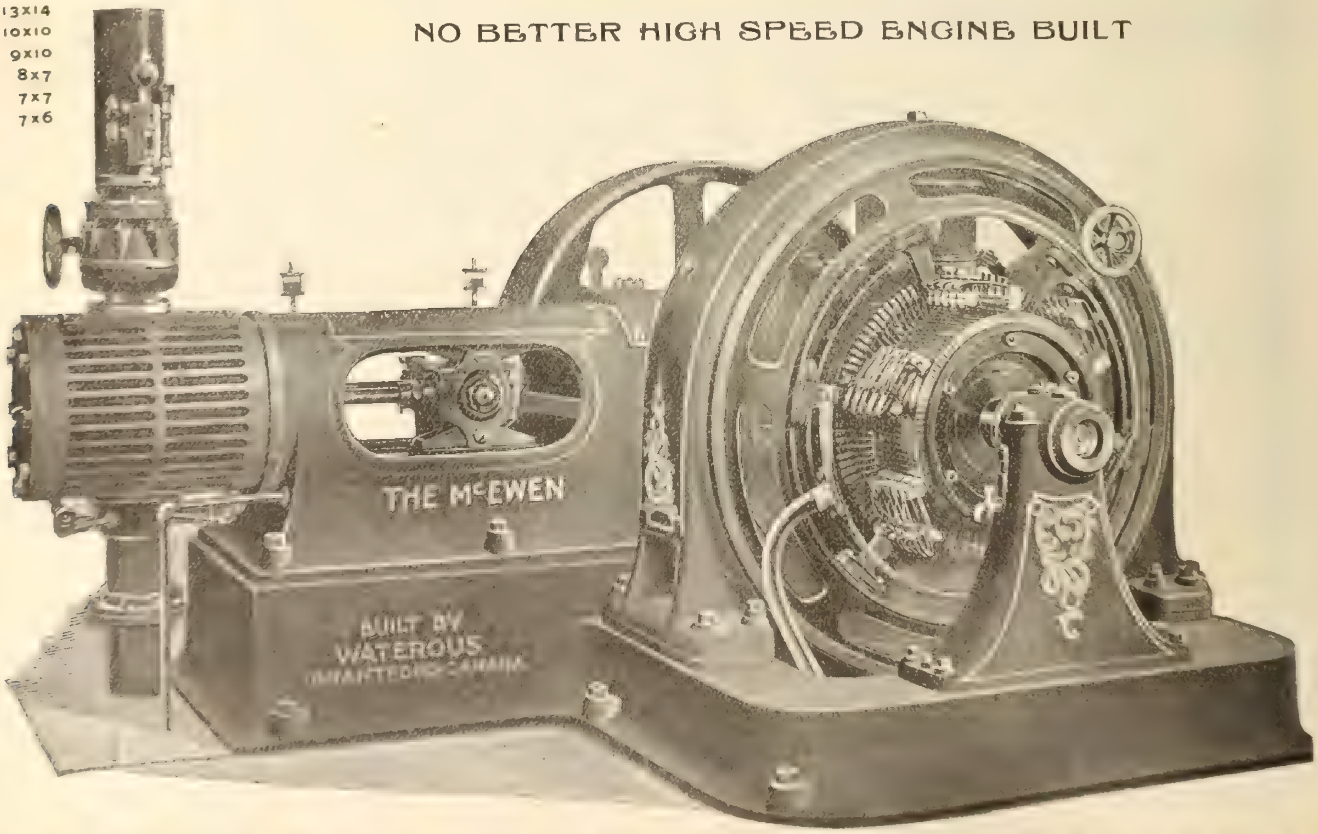

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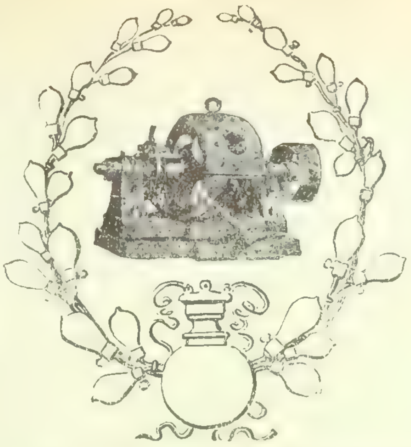

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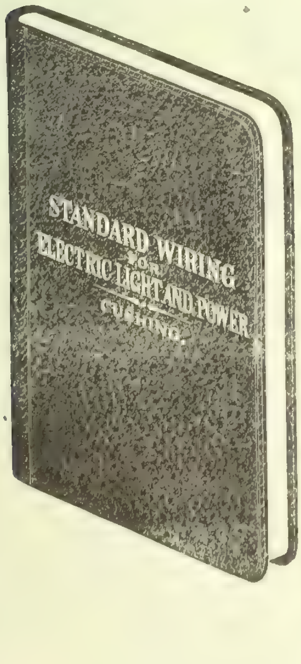

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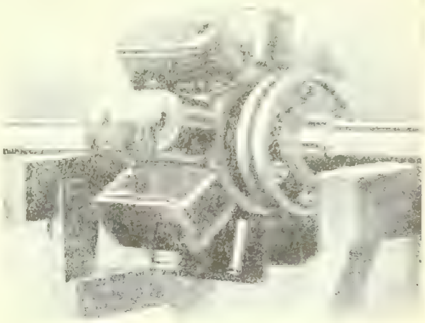

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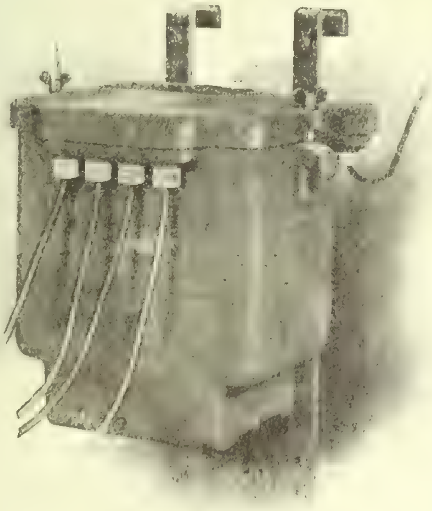

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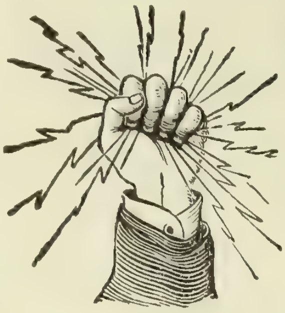

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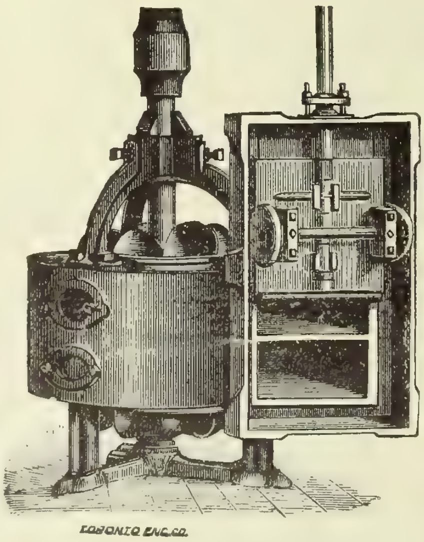
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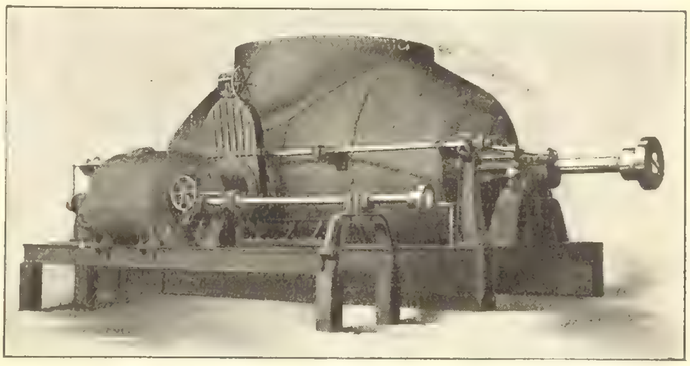

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(2) For a three-phase motor, 3 h.p. and 1,500 revs. per minute, the corresponding figures...... ...	45 per cent.	12 per cent	6.5 per cent.
(3) For a three-phase motor, 30 h.p. and 750 revs. per minute, the corresponding figures are......	30 per cent.	5 per cent.	2.5 per cent.

A one-half horse-power three-phase motor running at 1,500 revolutions per minute was tested, first without and then with counter-shaft, all bearings being of the ball type. The following efficiencies for half and for full load respectively were obtained: (1) Without counter-shaft, seventy-seven and seventy-eight per cent. respectively; (2) with counter-shaft, seventy-three and sixty-nine per cent. respectively.

ELECTRIC COUPLING OF DYNAMOS DRIVEN BY SINGLE-ACTING STEAM TURBINES.

An ingenious method of coupling dynamos driven by steam turbines has been developed by the Halske Actien-Gessellschaft, Berlin, in connection with single-acting turbines. For such turbines it has been proposed to allow the steam nozzles to revolve in an opposite direction to that of the moving vanes. By this means two shafts, revolving in opposite directions, are obtained; and with the same relative velocity of steam between the two working parts, as in an ordinary turbine, the two shafts have speeds that are half the absolute speed that the shaft of an ordinary turbine would have under the same conditions. It is not necessary that the two shafts revolve at the same speed. They may be coupled so that the power given off by both can be taken from one of them. However, since two dynamos, when operated in parallel, are coupled together electrically, each exerting a reciprocal action upon the other, the two revolving shafts of a turbine constructed as above may be used to drive the armatures of two generators, and a mechanical coupling may be dispensed with. The machines will thus tend to regulate each other, and if they are identical and equally excited, they will revolve at the same speed, and each deliver half the total power. Any variation in the excitation of one will be compensated for by a difference in speed, and, within certain limits, the loads may be distributed between the two machines in any desired proportion. In this turbine it is necessary to supply the steam to the moving nozzles through a hollow shaft.—Abstracted from the Mechanical Engineer, London.

A LARGE UNDERTAKING COMPLETED.

The Dodge Manufacturing Company, of Toronto, has completed its immense undertaking of furnishing special machinery and castings for the Harbor Commissioners' million bushel elevator at Montreal. Some 250 tons of machinery and castings from the company's plant at Toronto Junction have been supplied and the work has been executed in a manner thoroughly satisfactory to the contractors, Government inspectors and engineers, and which does credit to the Dodge Company. The hugh steel marine leg has been successfully hung in position in the tower and is said to be the largest in Canada. It was with a peculiar view of meeting the demands of jobs like this that extensive additions were made to the company's plant, which with its modern foundry of 15 tons per hour cupola capacity, travelling cranes, etc., the up-to-date machine shops and tool room, pattern shop and modern offices and engineering departments, is worthy of a visit.

Messrs. Gilman Bros. & Burden, of Pokiok, and H. W. Shaw, of Hawkshaw, have taken steps to secure the construction of an electric railway between Fredericton and Woodstock, N. B. It is understood that the Shaw, Cassels Company are willing to put $100,000 into the project.

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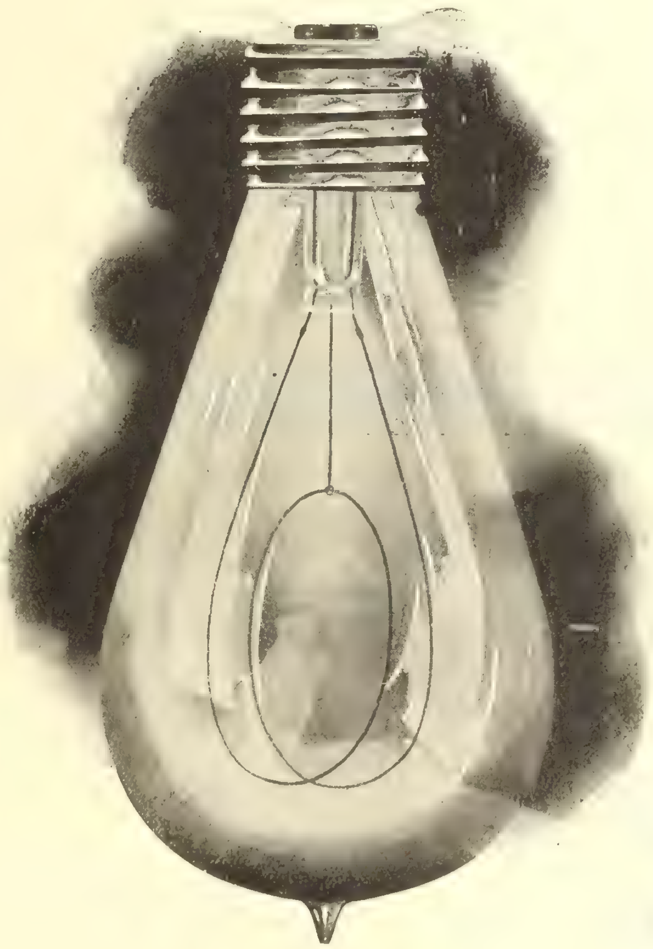

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SPARKS.

Mr. George E. Phillips has been appointed superintendent of the electric light and waterworks pumping station at Woodstock, N. B.

The ratepayers of Fort William, Ont., have approved of a by-law to raise the sum of $10,000 for improvements to the electric lighting system.

Mr. Hugh A. Allan and Hon. Raymond Prefontaine, Minister of Marine and Fisheries, went to Boston recently for the purpose of examining a system of submarine electric signals which are in use in and around Boston harbor.

A company has given notice that it will apply to the Manitoba Legislature for incorporation for the purpose of constructing an electric railway, telegraph and telephone systems and installing electric plants in the vicinity of Emerson, Man.

At the annual meeting of the Sherbrooke, Que., Street Railway Company, held last month, the following directors were elected : P. E. Clement, Rutland, Vt. ; H. D. Smith, Compton ; S. L. Clough, Lennoxville ; W.A. Moorehouse, Sherbrooke, and E. Harding, Boston.

The city council of Sherbrooke, Que., have offered the Sherbrooke Power, Light & Heat Company the sum of $200,000 for all the property of the company except the gas works. The previous offer by the council included the gas works.

The Eau Claire & Calgary Water Power Company, of Calgary, N.W.T., intend to install a new plant, to be a duplicate of the present plant but to be operated by steam instead of water power. It is also the intention to increase the water power plant.

The town council of Arnprior, Ont., has renewed for a term of ten years the street lighting contract with the Arnprior Electric Company. Former rates will prevail, and the council will have the privilege of substituting arc lights for incandescent lights in the central portion of the town. It is understood that the company will make improvements to their plant.

The Canadian Consolidated Oil Company has been incorporated at Hamilton, Ont., with a capital of $1,000,000. The promoters are Messrs. R. Clarkson, Thomas Ramsay, James Dixon, Leopold Baker, and H.B. Coburn. It is not the intention, for the present at least, to erect a refinery.

A new engine has been installed in the municipal electric light station at Glace Bay, N.S., also a new boiler of 150 h.p. purchased from the Robb Engineering Company, of Amherst. It is the intention to install a 250 kilowatt direct connected generator of the alternating current, revolving field type, together with new marble panel switch-board, of C. C. E. manufacture.

The directors of the Trinidad Electric Company, who met in Halifax on December 11 last, declared a quarterly dividend at the rate of 5 per cent. per annum. The earnings for the year amounted to about $100,000. The company's property in Trinidad consists of 12 miles of tramway and an electric lighting plant. Mr. John F. Stairs, of Halifax, is the president.

A meeting of the directors of the Canadian Telephone & Telegraph Company was held at the King Edward Hotel, Toronto, recently, with the president, Mr. Charles Robinson, of Scranton, Pa., in the chair. It was afterwards stated to be the intention of the company to operate both local and long distance lines throughout Canada on the same principle as the independent telephone companies in the United States. An effort will be made to obtain a franchise from the city of Toronto.

Mr. J. Phelps, of Baltimore, who was employed by the city of Montreal to prepare a report on the cost of constructing an underground conduit for electric wires, has completed his commission. He estimates that a suitable system would cost $1,205,100. He has given figures for four classes of conduits, ranging in cost from 34.68 cents to 45.9 cents per duct foot. The general scheme calls for the construction of main or trunk line conduits by the most direct routes into the respective territory which each is designed to feed, keeping as nearly as may be possible along the line of street railway tracks, to facilitate feeding to the trolley wires.

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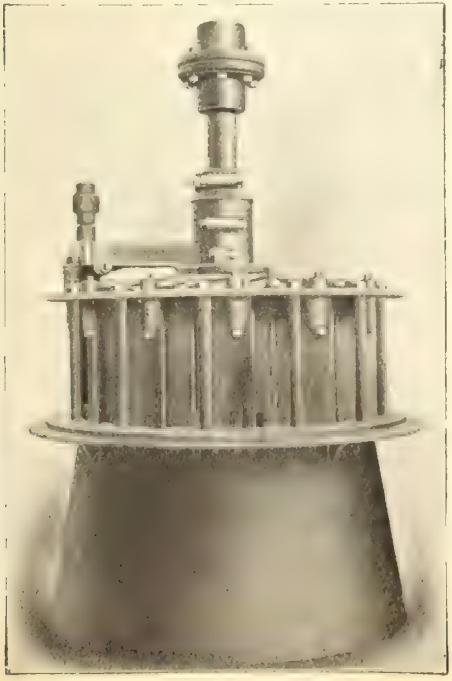

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SPARKS.

Tenders have been invited for the lighting of the town of Sydney Mines, N. S.

Municipal owership of the electric and gas plants at Ingersoll, Ont., has been defeated.

The Westmount Power & Transit Company, of Westmount, Que., has applied for a charter of incorporation.

The ratepayers of Owen Sound, Ont., carried a by-law to raise $25,000 for extensions to the gas and electric light plants.

The by-law for the purchase of the plant of the Perth Electric Light Company, Perth, Ont., was carried by a majority of 133 votes.

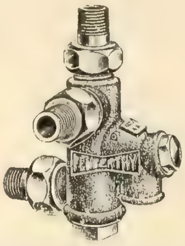
The ratepayers of Owen Sound, Ont., will vote on a by-law on January 4th to provide $10,000 for improving the electric light plant.

Mr. N.M. Cantin is at the head of a syndicate which propose to build an electric railway between Stratford to St. Joseph's, on Lake Huron.

The electrical contractors of the city of Winnipeg have formed an association for mutual protection and benefit. The first regular meeting will be held on January 5 at the offices of the E.S. Harrison Company.

Incorporation has been granted to the Maritime Engineering Company, Limited, with headquarters at Moncton, N. B. The promoters are Messrs. J. P. Weir, P. S. Archibald, F. W. Givan, Gordyn Baxter, Josiah Wood and William Christie.

The vote on a by-law to raise $45,000 for improvements to the lighting plant of the town of Brockville, Ont., resulted in a majority of 100 in favor of the by-law. Another by-law to amalgamate the light and power boards was defeated.



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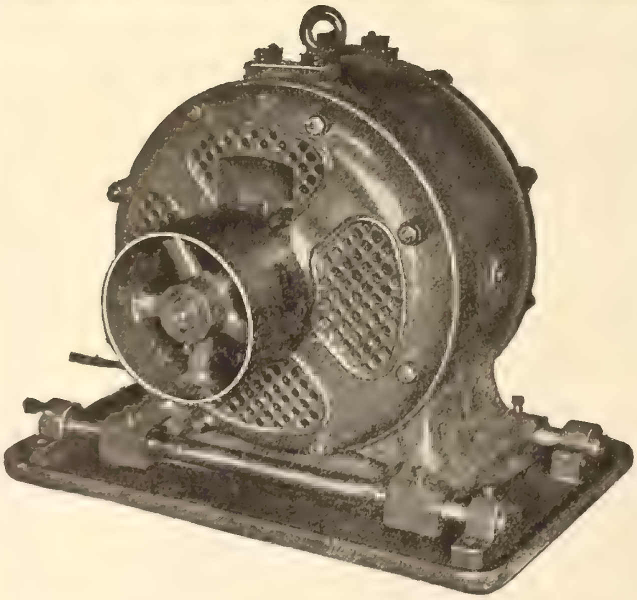

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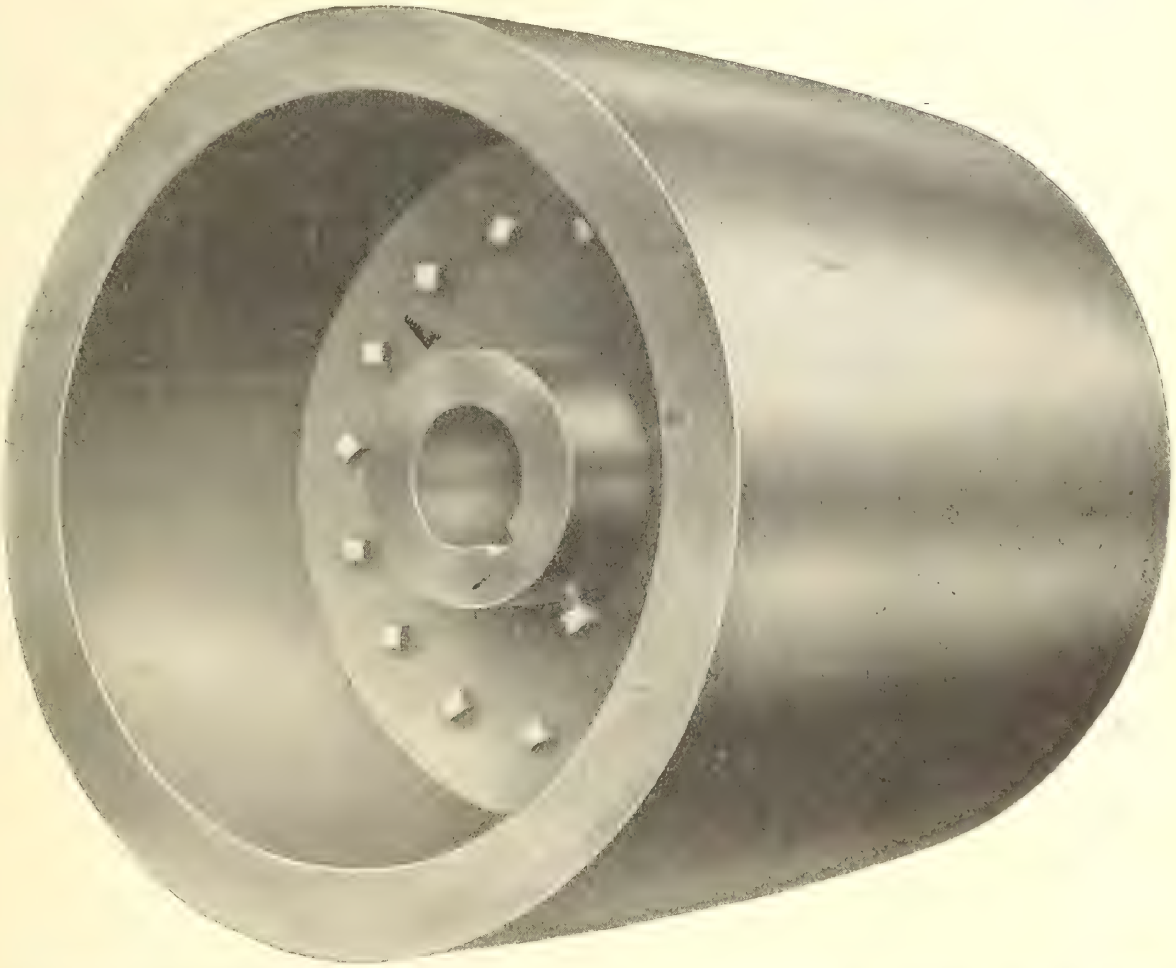

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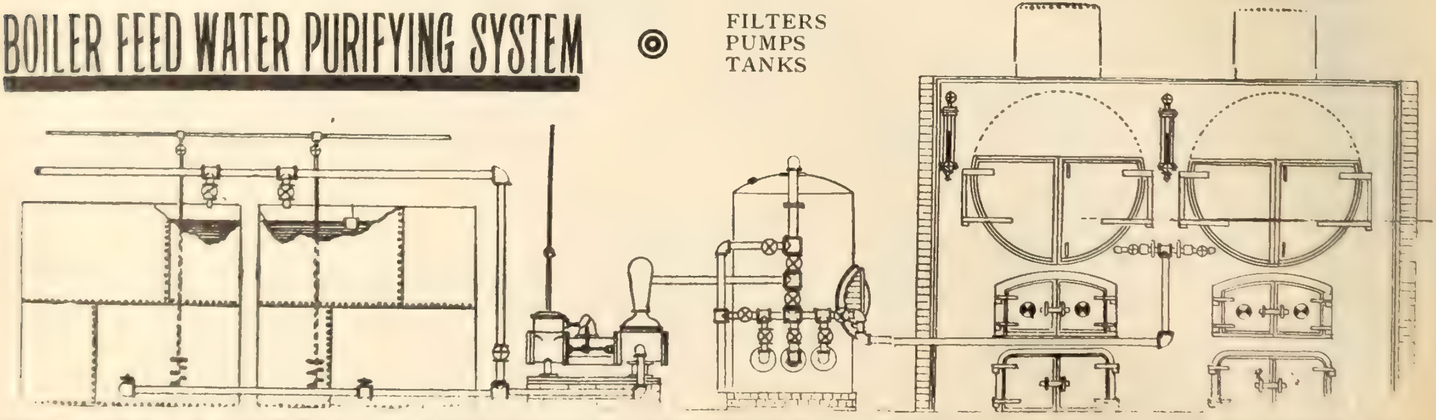

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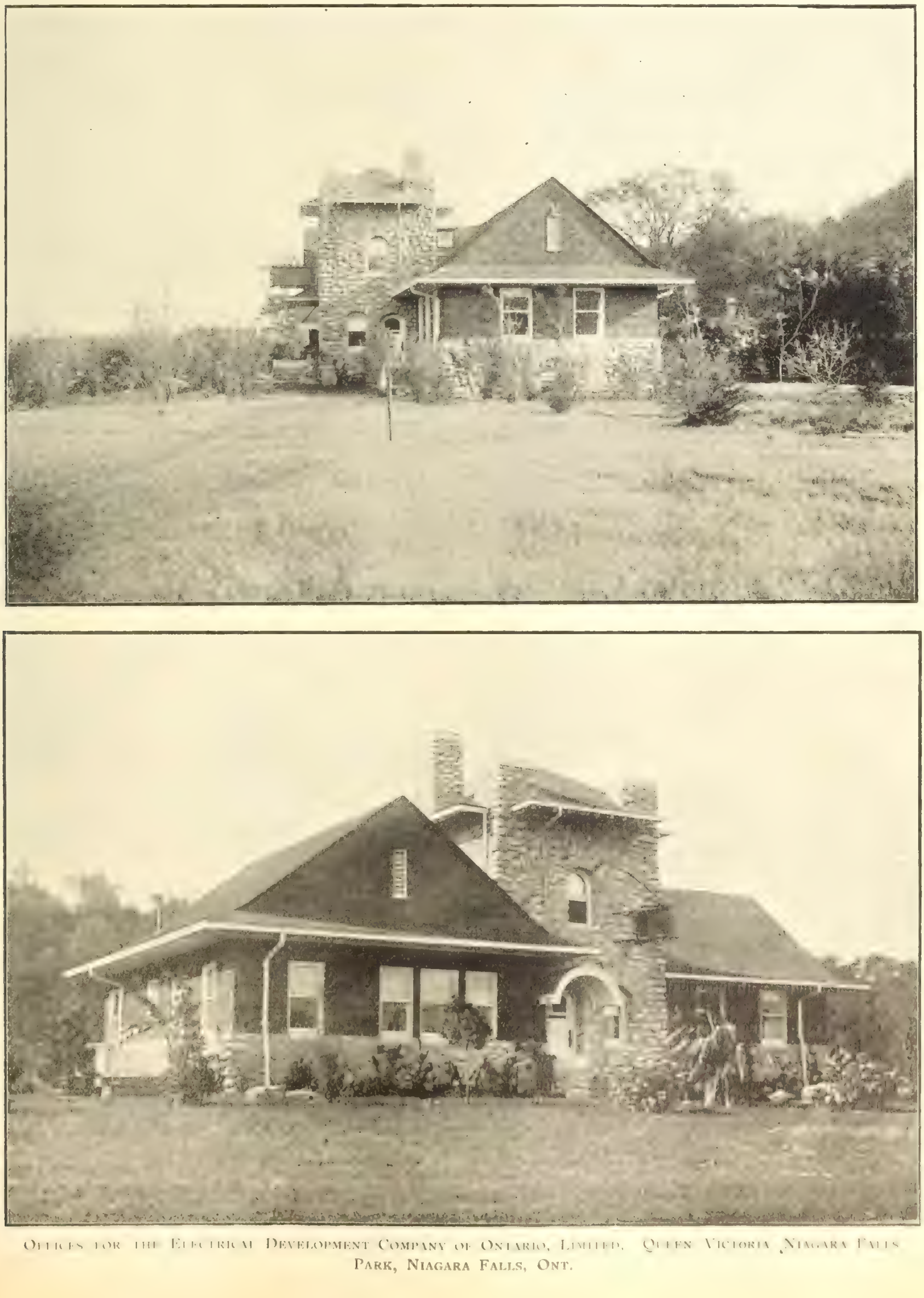
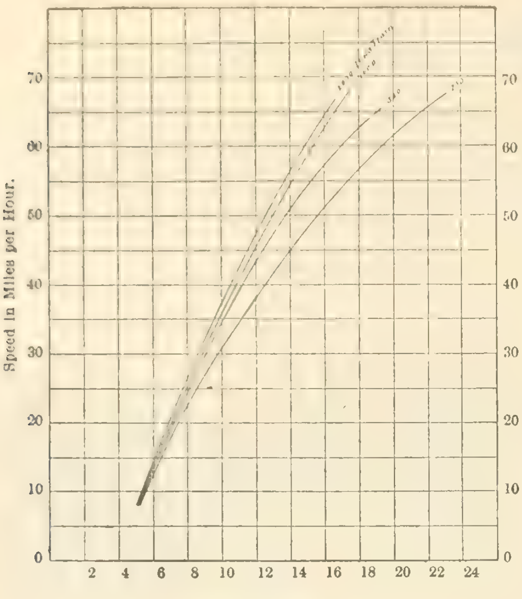


Offices for the Electrical Development Company of Ontario, Limited, Queen Victoria Niagara Falls Park, Niagara Falls, Ont.

SOME POSSIBILITIES OF THE ALTERNATING CURRENT SINGLE PHASE RAILWAY MOTOR.

By A. H. Armstrong.

The electric railway motor has replaced the horse and cable on our city streets, the steam locomotive on overhead and underground rapid transit lines, and has conclusively proved its exclusive right to operate suburban cars over distances reaching more than fifty miles from the outskirts of larger cities. All this has been accomplished with the direct current series motor operating at a potential approximating six hundred volts and with alternating current distribution to suitably located rotary converter substations. There are isolated cases where the electric motor has replaced the steam locomotive on steam lines, and where this has been done the increase in the dividend earning power of the road has been sufficiently great to warrant the extension of the electric service and the changing over of more steam operated lines. With the commercial development of the alternating current railway motor, new possibilities are introduced in electric railroading, owing to the much higher voltages for which the motor itself can be wound, and due also to the fact that alternating current is used directly as motive power without the expensive transforming apparatus required for the direct current series motor.



Curve Sheet 1.—Train Friction Curves.

The alternating three phase induction motor has been applied to traction work with doubtful success, owing to its practically synchronous characteristics, its limited output making it sensitive to the heavy voltage drops liable to occur in railway work, and due, furthermore, to the complication of double overhead trolley required for this type of motor.

During the past few years there have been developed several types of single phase alternating current motors having speed-torque characteristics even better adapted for railway work than that of the direct current series motor, and, furthermore, providing ample starting torque with any voltage variation liable to occur in practical electric railway operation. As these motors can be operated with a single trolley and ground return, and can, furthermore, be operated satisfactorily on either direct or alternating current, it makes their field of usefulness much greater than their direct current series competitor.

Having such a motor with practically no restriction as to voltage, it is possible to break away from the exclusive field of electric traction with frequent service and small units and consider the operation of freight and passenger trains over our regular steam lines. In order to arrive at some general conclusions not limited by the local considerations of a specific case, this paper is devoted to a somewhat brief and general discussion of the operation of our steam lines by the alternating current railway motor.

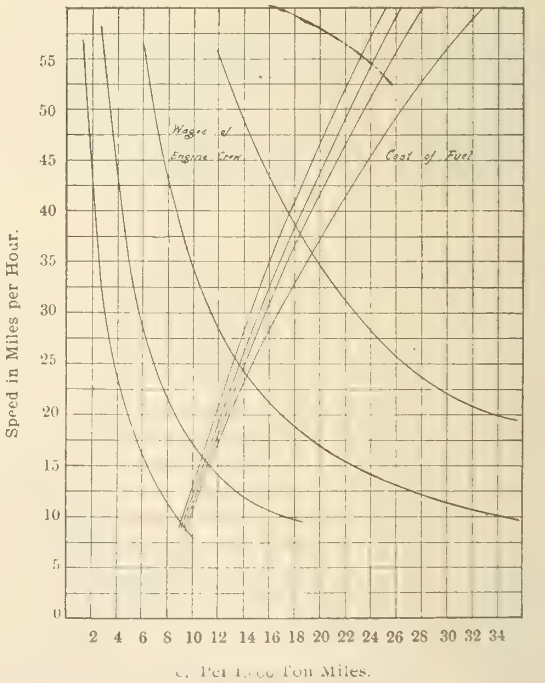
To make the conclusions general, trains of different weight have been taken, operating at different speeds and varying headway over a level track. As being typical, train weights of 2,000, 1,000, 500, and 250 tons of 2,000 lbs. have been selected. As the investigation of the operation of these trains will be carried to maximum speeds of 60 to 70 m.p.h., the total fricton of the train expressed in pounds per ton is given in curve sheet 1. This friction is not that of the trailing load, but includes the running and wind friction of the locomotive itself.

From a number of tests a steam consumption of approximately 30 lbs. per I.H.P. hour is taken as the basis of all locomotive work. It is assumed that locomotives are compound, as this steam consumption could hardly be expected with simple engines under average conditions. To make all results comparable further assumptions are made of an evaporation of 7 lbs. of water per pound of coal, an engine efficiency of 85 per cent., and cost of coal at $2.00 per ton of 2,240 lbs. The price of fuel will vary and this is considered later. As we are figuring upon actual performance of the locomotive, that is, work done in overcoming train friction, it will be necessary to introduce a factor allowing for coal wasted in making up and damping fires, and general waste incident to locomotive practice when standing idle for a large part of the twenty-four hours. Furthermore, a steam locomotive is called upon to operate throughout the year at varying temperatures of the surrounding air, and coal consumption during the winter months is in excess of that during the summer. This excess may reach 20% as an average during the cold weather, and hence 10% additional fuel is charged to the locomotive for the work assumed, to take care of different conditions of operation which the electric locomotive does not have to contend with.

On the basis of the above assumptions, all of which are the result of practical tests, curve sheet 2 is obtained :—

These figures check up reasonably close with the locomotive performance sheets for steam roads after superfluous mileage has been deducted from the total mileage given. As an example the shifting locomotives and pushers are charged with so many miles per hour and often do not make one-third the mileage charged to them, so that locomotive performance sheets, as published, sometimes indicate too low a coal consumption per 1,000 ton mile of actual work done.

The next item of considerable expense in steam operation is the labour account. As it is immaterial to the train crew whether steam or electric locomotives are supplied, this item will not be entered into. The engineer and fireman, however, are greatly influenced by the character of the motive power. In steam operation a crew working ten hours a day average for the railroad company will not be in active service on the road more than forty or fifty per cent. of the time, the remainder of the time being taken up in caring for the locomotive. In electrical operation the full time of the crew can be utilized for active duty, and hence a considerable saving effected in this item. In steam operation a crew costing $8.50 for ten hours labor has been assumed to be in active commission for five hours per day,



Curve Sheet 2.—Cost of Steam Operation.—Coal $2.00 per 2,240 lbs.

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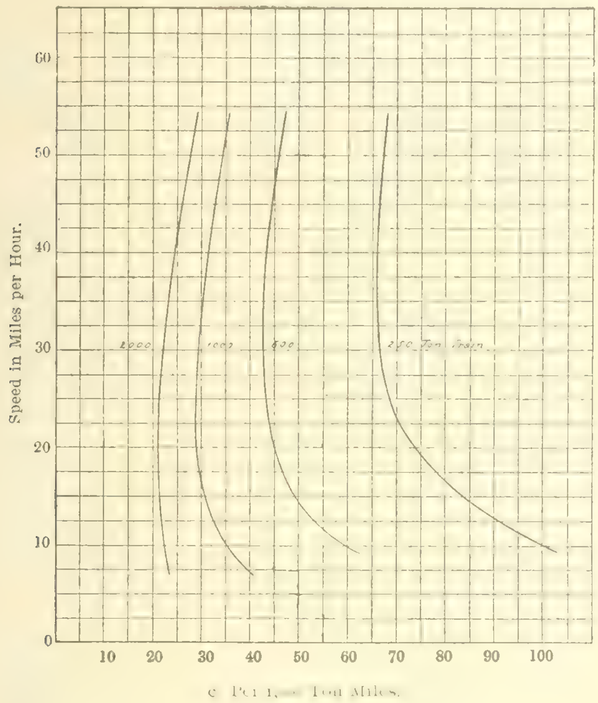
* Abstract of paper read at a recent meeting of the Electrical Section of the Canadian Society of Civil Engineers, Montreal.

while in electric service the crew is assumed to be in commission 8.3 hours per day out of the ten. For shorter hours of labor the same proportion would hold true, and the crew for the electric locomotive will cost but sixty per cent. of that for the steam locomotive. The cost of wages per thousand ton mile is given in curve sheet 2.

In order to approximate the repairs on steam locomotives of different capacities, it is assumed that the locomotive will have its weight proportioned to the trains which it is to handle, and as a basis of the repair item, the following values are assumed, agreeing closely with the results of compound locomotive in actual service.



CURVE SHEET 3.—COST OF STEAM OPERATION.—COAL $2.00 PER 2,400 LBS.

STEAM OPERATION—REPAIRS, CENTS PER 1,000 TON MILE.

250 tons	25	cents.
500 tons	13.8	"
1,000 tons	7.7	"
2,000 tons	3.3	"

The items of oil, waste and water are not determined here at length, but are introduced in the final values obtained for operating expense. Combining the figures obtained above for steam operation, including fuel at $2.00 per 2,240 lbs., engine crew at $8.50 per ten hours (five of which are in actual service), repairs, oil, waste, water, etc., the results in curve sheet 3 are obtained.

It is evident from the curves that each weight train can be run at a certain speed with a minimum expense for operation, this speed varying with the weight of the train. This economical speed will, of course, vary with any variation of the constants assumed above, such as the price of coal, labor, etc., but the values obtained are instructive and are given below :—

SPEEDS OF ECONOMICAL OPERATION.

250 tons	38	m.p.h.
500 tons	28	"
1,000 tons	23	"
2,000 tons	19	"

Considerable latitude is given above and below these speeds without greatly increasing expense per 1,000 ton mile for operation.

Coming now to the determination of the cost of operating an electrically propelled train under the same conditions, we arrive at some very interesting results due to the low first cost of electrically equipping the proposed steam line afforded by the alternating current single phase motor.

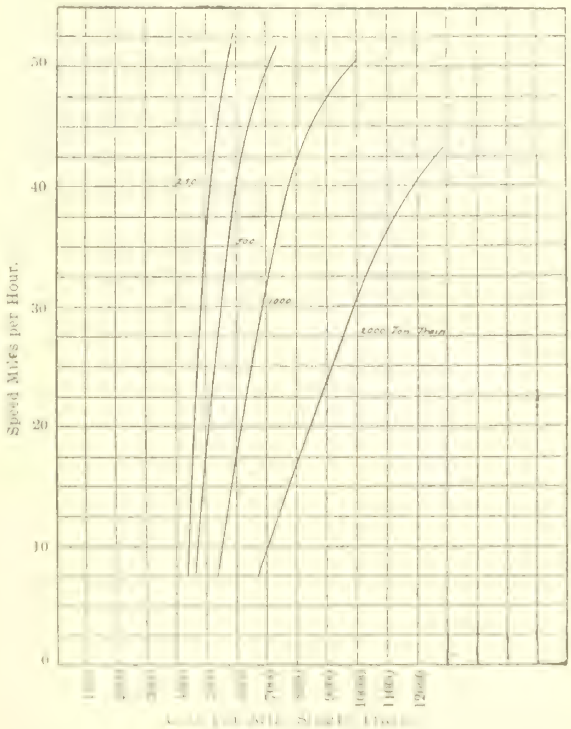
The same friction values are used as given in curve sheet 1 for steam operation. From these values the kilowatt capacity of each train is determined for the different speeds and varying weights of trains. From these values the cost of trolley copper, step-down line transformers and generating station are determined. The electrical system consists, in brief, of a generating station controlling one hundred miles of track, that is, feeding fifty miles in either direction. At intervals of approximately twelve miles are installed step-down transformers reducing the transmission potential to 3,000 volts or more for the trolley potential. This trolley potential is assumed at 3,000 volts for a good majority of the results, but for heavy work, that is, 1,000 and 2,000 ton miles the voltage is somewhat increased, but nowhere exceeds a safe operating value. The transmission potentials also are kept entirely within practical limits. The generating station does not get excessively large and the electrical system throughout presents no features of unusual interest, but rather duplicates work that is deing done throughout the country. By keeping all values within conservative limits, the results obtained become of practical application and not of theoretical interest.

The cost of installing the electric system complete, including generating station, transformer sub-stations, transmission line poles, bonding of track etc., is given in the following table:—

COST OF ELECTRICAL INSTALLATION.--COST PER MILE SINGLE TRACK.

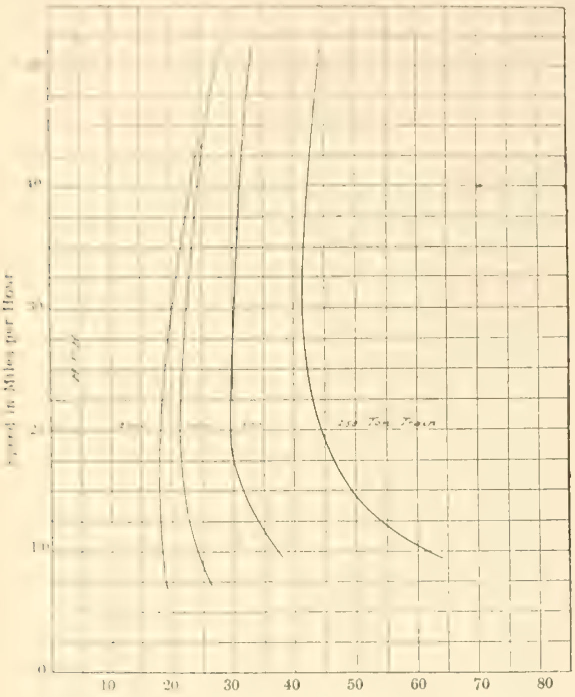
M.P.H.	5 trains each way.	10 trains each way.	20 trains each way.
	2,000 ton train.		
10	5,600	7,020	9,860
20	6,520	8,490	12,430
30	8,410	9,840	14,580
40	11,690	11,910	16,770
	1,000 ton train.		
10	4,800	5,500	6,920
20	5,200	6,200	8,100
30	6,250	6,900	9,400
40	7,600	7,700	10,600
50	9,820	9,820	12,700
	500 ton train.		
10	4,400	4,700	5,400
20	4,500	5,100	6,000
30	5,100	5,500	6,800
40	5,900	6,000	7,500
50	7,100	7,100	8,600
	250 ton train.		
10	4,200	4,400	4,800
20	4,300	4,600	5,000
30	4,600	4,800	5,400
40	5,100	5,200	6,000
50	5,700	5,700	6,600

The above tables are given at length, as they form very interesting reading, showing how the cost increases with the size of the unit rather than by the frequency of the trains. Also it is very necessary to arrive at an initial cost of electrical installation somewhat accurately, as this constitutes a funded debt upon which the saving, if any, between electrical and steam operation must pay dividends.



CURVE SHEET 4.—COST OF ELECTRICAL INSTALLATION, TEN TRAINS EACH WAY PER DAY.

In determining the cost of electrical operation it has been nec essary to consider the cost of producing power, and a sliding scale has been taken for the different kilowatt outputs, ranging from four mills per KW. hour to nine or more, with coal at $2.00 per ton, depending upon the KW. capacity of the generating station. It is assumed that steam turbines and modern methods of generating station construction are used, looking to the greatest economy of operation. Wages of engine crew, as stated, are taken at sixty per cent. of those for steam operation. Repairs for electrical locomotives are given in the following table:



CURVE SHEET 5. -COST OF STEAM OPERATION.—COAL, $2.00 PER 2,240 LBS.

ELECTRICAL LOCOMOTIVE REPAIRS.

250 tons	.8	cents per 1,000 ton mile.
500 tons	4.8	" " " " "
1,000 tons	2.3	" " " " "
2,000 tons	1	" " " " "

These repairs, in common with that given for steam operation, include all running repairs, overhauling and renewals. The cost of electrical operation is given complete in curve sheet 5, which are directly comparable to the cost of operation for steam previously given. It is obvious that as there is a fixed charge of five per cent. depreciation and repair account on the entire electrical installation, it is necessary to consider the frequency of travel over our proposed route. In order to make it as general as possible, it has been assumed that there will be five, ten and twenty trains per day each way. The cost of operation expressed in cents per 1,000 ton mile does not vary greatly with the different frequency of trains, but the dividend account must be based upon a selected train frequency. For convenience, a train frequency of ten per day each way is taken, and the cost of electrical operation given. For other frequency of trains, the cost of operation per 1,000 ton mile will not vary more than one or two cents either way from the results given in the curves and they are, therefore, of fairly general application.

By comparing this curve with that given for steam operation, a considerable saving is shown, giving varying dividends depending upon the frequency of travel, weight of train, maximum speed, etc. In fact, frequency of travel and weight of train are the determining features in considering the adoption of electric transportation. In order to show the dividend earning power, that, is the saving in electric operation over steam as the percentage of the cost for electrical installation, the three following tables have been prepared for a frequency of train service of five, ten and twenty trains each way per day.

INTEREST ON ELECTRICAL INVESTMENT, FIVE TRAINS PER DAY EACH WAY.

M.P.H.	2,000 tons.	1,000 tons.	500 tons.	250 tons.
10	5.75%	8.17	9.25	9.22%
20	3.88	4.92	5.73	6.02
30	1.51	3.82	4.1	4.85
40	....	3.47	3.68	4.07
50	....	...	3.36	3.74

TEN TRAINS PER DAY EACH WAY.

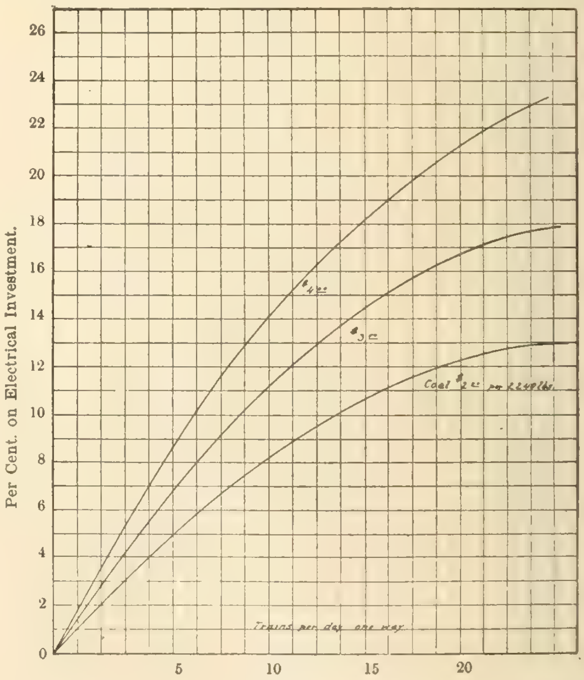
M.P.H.	2,000 tons.	1,000 tons.	500 tons.	250 tons.
10	8.48%	14.8	17.5%	18.3%
20	4.68	8.87	11.05	11.9
30	1.31	7.2	8.1	9.65
40	....	6.8	7.62	8.14
50	....	....	6.72	7.48

TWENTY TRAINS PER DAY EACH WAY.

M.P.H.	2,000 tons.	1,000 tons.	500 tons.	250 tons.
10	8.92%	23.1%	31.4%	34.5%
20	2.6	12.9	19.1	22.1
30	....	9.8	13.65	17.8
40	....	9.73	12.8	15.0
50	....	....	11.25	13.7

As shown by the above tables, electric locomotives cannot compete with steam for trains of 2,000 tons at higher speeds, owing to the enormous cost of equipping the road electrically with the constants chosen. Should such heavy railroading be contemplated electrically, it would be necessary to adopt longer transmissions than the fifty miles either way from the power house assumed, and which is very conservative, also the use of higher voltages on the trolley than the 5,000 or 6,000 volts maximum assumed in arriving at the tables. The scope of the paper has been limited, however, to the use of standard apparatus and voltages met with in every day practice. The results given thus represent the practice of to-day and not what electrical engineers may be able to do sometime in the future. The consideration of the operation of 2,000 ton trains at speeds of 50 or 60 m. p. h. is hypothetical, as no steam locomotive could be constructed that would furnish sufficient power to haul a train of this weight at the speeds considered. The problem is feasible from an electrical standpoint, as the weight of the locomotive could be distributed among a number of units distributed throughout the train to lessen the draw bar pull without exceeding a permissible weight per axle.

The discussion of the paper has been limited thus far to the use of coal costing $2.00 per ton for both steam and electric locomotive work. It is a well known fact that generating stations can use cheaper coal than it is economical to use on steam locomotives, and hence it is interesting to follow through the results with varying prices of coal. In figuring the cost of coal, it is assumed that coal will be charged to operation at the price for which it could be sold in the wholesale market at the locality used. Coal at $2.00 per ton is somewhat cheap, especially for some of the western roads, and the same method of figuring has been used in determining the earning capacity of the electrical installation for $3.00 and $4.00 coal as well. As the saving in electrical operation and its percentage of the cost of installing the electrical system are of fundamental importance, the table for interest earning capacity expressed as percentage of the electrical installation is given in the following tables both for $3.00 and $4.00 coal.



CURVE SHEET 6. -NET EARNINGS ELECTRICAL INSTALLATION, 1,000 TON TRAIN UNITS.

COAL AT $3.00 PER 2,240 LBS.—INTEREST ON ELECTRICAL INVESTMENT.

Five Trains per Day Each Way.

M.P.H.	2,000 tons.	1,000 tons.	500 tons.	250 tons.
10	8.35	10.6%	10.8	9.6
20	6.77	6.8	6.9	6.4
30	4.35	5.8	4.85	5.02
40	8.12	5.5	4.94	5.0
50	...	....	4.7	4.67

Ten Trains per Day Each Way.

10	12.8	17.4	19.5	19.4
20	8.77	12.1	13.2	13.
30	7.3	10.75	10.	11.1
40	6.	10.75	10.47	10.3
50	....	...	9.4	9.34

Twenty Trains per Day Each Way.

10	14.9	27.8%	38.4	36.3
20	8.2	17.7	22.6	23.8
30	7.9	15.	17.	20.1
40	6.25	15.2	17.3	18.1
50	. .	...	20.4	16.9

COAL AT $4.00 PER 2,240 LBS.—INTEREST ON ELECTRICAL INVESTMENT.

Five Trains per Day Each Way.

M.P.H.	2,000 tons.	1,000 tons.	500 tons.	250 tons.
10	11.0	11.65	11.6	10.2
20	9.65	8.65	8.15	7.19
30	7.04	7.74	6.35	5.72
40	5.64	7.54	6.2	5.75
50	....	....	6.13	5.6

Ten Trains per Day Each Way.

M.P.H.	2,000 tons.	1,000 tons.	500 tons.	250 tons.
10	16.8%	20.8%	21.4	20.4%
20	13.4	15.8	15.2	14.7
30	12.0	12.3	14.2	12.7
40	10.72	15.	12.8	11.8
50	....	....	12.2	11.2

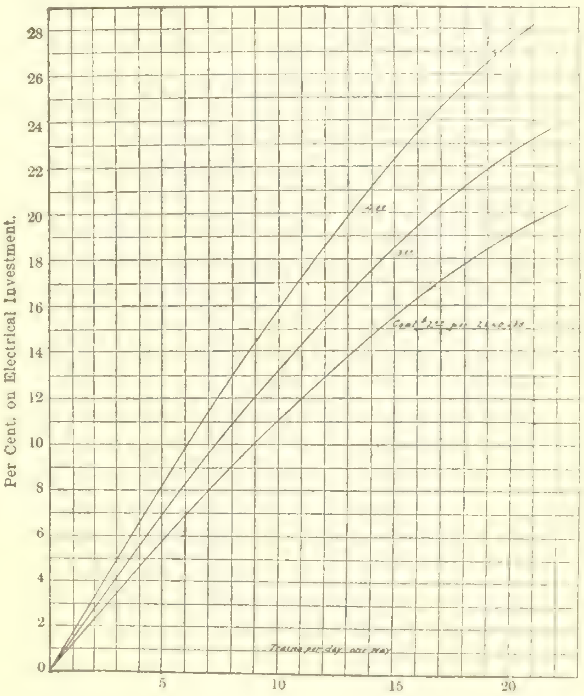
Twenty Trains per Day Each Way.

10	21.1	33.2	38.4	38.0
20	14.8	22.9	27.4	25.6
30	16.8	20.9	20.3	22.6
40	12.4	20.9	21.1	20.7
50	....	....	20.4	20.1

A study of the above tables brings out the fact that for very infrequent service, that is, five trains per day each way or less, it would hardly pay to equip the road electrically, there being a dividend of from four to seven per cent. on the capital invested. With more frequent service, however, the saving in electrical operation becomes more marked until at from fifteen to twenty trains per day each way the interest earning power of the electrical investment is worthy of very careful consideration. It should be borne in mind that all these figures do not contemplate increase in the present traffic of the road, and, therefore, do not take into consideration one of the chief characteristics of electric traction, that is, developing short haul local traffic and thus increasing the dividends by increasing the receipts rather than by cutting down operating expenses. The well known ability of electric roads to greatly increase previous steam traffic has led them to be installed, in many cases, without too close an investigation into their economical installation. The electrically equipped road, while caring for the heavy through freight traffic with an earning capacity of from four to seven per cent.on the investment, can also build up a local traffic both freight and passenger, with practically no additional cost and showing very large returns.

Taking up the possibilities of the alternating motor in general haul work, the problem had to be treated in a very general way in order not to lose sight of the scope of the problem in considering local details. The average specific problem has its local conditions, which must be carefully considered in detail, and, in many cases, would show a greater return for the money invested than indicated in this paper. For instance,all power is supposed to be generated from coal from power house devoted to the interests of railroading alone. Along many of our roads exist water power facilities which could be advantageously developed and furnish power much cheaper than the figures assumed from coal generation. Futhermore, the cost of power in the smaller generating station capacity has been assumed as high as one cent per kilowatt hour or more, and should a generating station supply other industries, such as mining, lighting, general power distribution, etc., the cost of purchasing power would be considerably decreased with a consequent reduction in cost of operating electrically. The results given in the table therefore are of general application only and may be considerably modified when considering the local aspect of a given proposition. It is believed, however, that the results as obtained are based upon conservative assumptions, in fact, most of these assumptions were obtained from operating conditions, and, with the figures given, outline somewhat briefly the possibilities of the alternating current single phase motor in the railway field.

The operating expenses considered include fuel, wages, repairs, oil, waste, water, and five per cent. depreciation on the electrical installation. No depreciation is charged off against the locomotives, as although the electric locomotives cost more than the steam, they will permit of a greater mileage, so that the total capital invested in locomotives should be practically the same in either case. There are a number of expenses incidental to steam operation other than those considered which must be done away with with the adoption of the electric locomotive. While each of these expenses is small they may amount to considerable in the aggregate. For example, the electric locomotive is double ended and requires no turn table. Two electric locomotives can be coupled together and operated by one engineer in the cab of the leading locomotive, each locomotive doing an equal share in hauling the train. In fact, it is not strictly necessary to consider the use of a fireman in electric propulsion, as his duties will be largely confined to ringing the bell, and waiting for the engineer to die of heart disease. His services can be dispensed with entirely if we consider that the electric locomotive cab can be made the caboose for the train, and the train crew serve as a reserve for the engineer in case of trouble. The cost of fuel has been assumed equal in both cases, but there is an added expense in handling the fuel for steam operation, as the source of supply of the locomotives is distributed in small pockets over considerable track, each pocket requiring more or less outlay for its establishment and maintenance, all of which can be saved by electric locomotive fed from a central generating station. The increasing tendency towards the adoption of very heavy trains calls for heavier locomotives with consequent increase in weight of rail, cost of bridges, ballasting track and general maintenance of the right of way.



CURVE SHEET 7.—NET EARNINGS ELECTRICAL INSTALLATION, 500 TON TRAIN UNITS.

Indeed, the wear upon a light rail with a heavy reciprocating engine must be considerably more than that given to the rail by an electric locomotive of half the weight and having a perfectly uniform rotary impulse imparted to the drivers. Just how much money may be saved by the lessened maintenance of the track is conjectural and hence has not been entered into here, but the figure must reach a considerable size for heavy locomotive work. As the maintenance of electric locomotives is considerably less than its steam competitor it will reduce the size of repair shops required, the difference in the interest on which would appear as a fixed charge against steam operation. Furthermore, a steam locomotive including a tender has not more than fifty per cent. of its weight upon the drivers, which will constitute from seven to ten per cent. of the average train weight. As this is a dead weight, producing no revenue, it would be fair to compare the two systems by estimating upon a train for steam operation from seven to ten per cent. heavier than for electric operation. The comparative figures given in the table based upon 1,000 ton miles are not, therefore, entirely fair toward electric operation, but should be somewhat increased for haulage involving the use of the steam locomotive.

The earning capacity of the money invested in electric equipment can be looked upon, therefore, as exceeding the value given in the tables, but as stated above local conditions will largely affect the application of the general figures to any given example. Should all the factors entering into the engineering expense of operating roads by steam and by electric locomotives be carefully considered, the possibilities opened up by the use of the alternating motor are sufficiently great to warrant its replacing the steam locomotive in many of our railway systems, either in part or for the complete system.

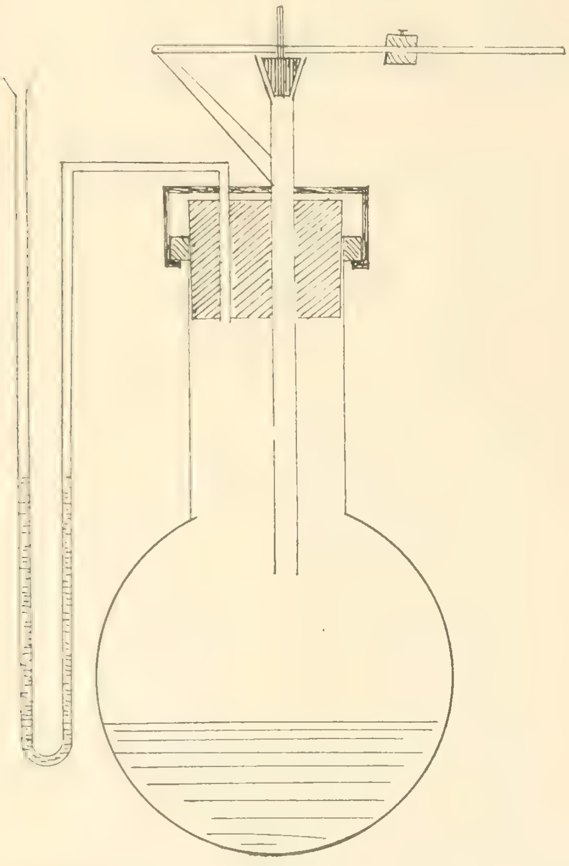
AN EXPERIMENTAL STUDY OF THE CONDITIONS OF "FOAMING" IN STEAM BOILERS.

By A. McGill, B.A., Etc.

The following simple apparatus has served me to demonstrate most of the phenomena of foaming, and to study the conditions which produce and govern this effect of the use of many natural waters for steam-making.

The apparatus consists of a copper flask of about 400 c.c. capacity, closed by a rubber stopper, which is held in place by a clamp passing under the edge of a flange on the neck of the flask.

Two perforations in the stopper carry respectively a bent glass tube, containing mercury, which serves as a pressure gauge, and a brass tube, of ½ inch diameter, about 6 inches long, open below, and fitted above with a ground valve, and a lever by which variable pressure can be put on this valve. The brass tube can be adjusted in relation to the level of the water in the flask, by simply pushing it up or down. In use, it is pulled up until such a space is left above the surface of the boiling water as to cause dry steam only to escape through the valve, when the pressure is suddenly lowered from 10 to 5 inches of mercury (= 5 to 2½ lbs. per square inch).



Apparatus Used to Demonstrate the Phenomena of Foaming in Steam Boilers.

The moveable weight is placed in such a way that steam blows off at 5 inches mercury pressure. The lever is held down, by a rod in the hand, until the pressure rises to 10 inches. On now releasing the lever steam escapes with violence, and its character as dry or wet, as accompanied by little or by more water, is easily observed.

It is scarcely necessary to add that, in comparative tests, the same gas flame must be used in heating the flask.

I have worked with 150 cc. of water in each experiment. The solid matter, which I have added to the water, is powdered chalk in most cases. In the few instances where I have used fullers' earth, lamp black, etc., I have obtained results that seemed to show no difference due to specific character of the solid matter. It is so easy for anyone interested to verify my results for himself that I shall simply state these generally, instead of describing in detail a series of experiments.

1. The first general condition which causes foaming is the sudden superheating of the water in the boiler, due to reduction of boiler pressure by drawing off steam.

2. With distilled water, foaming does not result under the conditions named.

3. With a clear space of one inch between the water surface and the safety-tube, foaming does not occur with distilled water, even on addition of 500 milligrammes of powdered chalk.

4. When carbonate of soda is in solution in the proportion of 1 gramme Na_2CO_3 per litre, the escaping steam is charged with much water, even though the water in the boiler is quite free from particles of solid matter in suspension.

5. When carbonate of soda is present to the extent of 0.25 grammes per litre, the steam is distinctly wet, but no great amount of water is thrown out.

6. On addition of powdered chalk to the last named solution, very violent projection of water occurs.

7. All salts of sodium that I have tried produced foaming waters, even when the water is clear, when present to the extent of 1 gramme per litre.

8. Sodium salts seem to produce intensity of foaming in the following (decreasing) order :—Stearate, Carbonate, Silicate, Sulphate.

9. The presence of solid particles in suspension invariably increases the violence of the foaming.

10. Saturated solution of caustic lime does not foam violently ; but the addition of a minute trace of any saponifiable fatty matter causes violent foaming.

11. Fatty matter, in a certain amount, will produce foaming, even if added to distilled water ; but a mere trace, having no appreciable effect in the case of a neutral water, causes violent foaming if the water be alkaline either with lime or with soda, but more markedly with the latter.

12. Pectous matter (swamp waters) if at all concentrated, produce foaming, and especially when solid particles are present.

13. Tannin, in small amount, does not seem to cause foaming.

It must be kept in mind that these conclusions are drawn from work with a spherical copper flask, heated below by an ordinary gas flame, and that they are true of a varrying pressure of 5 inches mercury between the limits of 10 and 5 inches above atmospheric pressure.

I have made a few experiments at higher pressures than 5 to 10 inches mercury, but not exceeding 20 inches (10 lbs. per square inch). So far as I can judge, the effects, for sudden reduction from 20 to 15 inches mercury, are more violent than for reduction from 10 to 5 inches ; but it would be necessary to use a stronger and larger apparatus to properly investigate this feature.

I think the results put on record justify the following general conclusions :—

1. Foaming is due to sudden rednctions of steam

pressure in the boiler, producing a superheated water.

2. Floating particles, by forming scattered nuclei which facilitate the sudden disengagement of steam, increase the tendency to foam.

3. Anything in solution which tends to increase the "toughness" of the liquid, and thereby make high surface tensions possible, increases the violence of the foaming.

I may say that these conclusions are consistent with the facts observed by practical men (locomotive engineers and firemen), who tell me that it is when an engine is doing heavy work that foaming is most noticed; also, that the concentration of water in the boiler increases foaming; that, other things being equal, a water foams worst when very turbid, etc.

The following practical inferences may be drawn from what I have said :—

First : The content of sodium salts must be kept down to a minimum. Marked foaming takes place, under 10 lbs. pressure, when the soda (Na_2O) reaches 1500 per million. At 200 lbs. pressure it is presumable that the foaming limit will be reached at a much lower concentration. Practical men have assured me that no water containing 300 Na_2O per million is fit to make steam with. A concentration of 5 : 1 would bring such a water up to 1500 per million.

Second : Caustic lime in excess will cause foaming in presence of saponifiable fats, which are always present, in traces, in boiler concentrates. Hence the necessity of avoiding excess of lime in water treatment. Of course, this applies still more strongly to the case of caustic soda in excess.

Third : Solid matter in suspension predisposes to foaming. It is impossible that boiler concentrates should be free from suspended matter, but care should be taken to provide a feed water which is clear at first and is of such a character as to deposit a minimum of solid matter on being boiled.

OTTAWA, CANADA, November 5th, 1903.

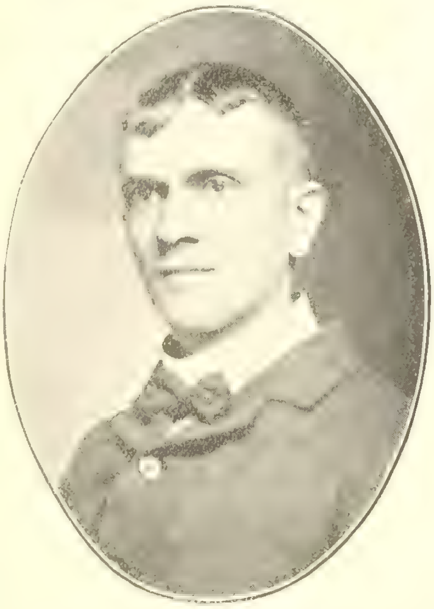
CHARLES HENRY HINES, M. I. E. E.

Charles Henry Hines, M.I.E.E., whose portrait we show on this page, stands among the firsts electrical engineers of to-day. Born with a love for the mechanical, he in early life proceeded to acquire that technical and theoretical knowledge which he afterwards put in practice to so good advantage. His experience has been varied and thoroughly practical, and his appointment to the responsible position of electrical engineer for the Canadian Pacific Railway is well deserved.

Mr. Hines first saw the light of day at Buffalo on March 6th, 1865. He was educated in the public schools of Plainfield, N. J., where he took an academic course. He acquired technical knowledge by private study, correspondence courses in engineering, and as a student in the testing department of electrical companies.

In 1884 Mr. Hines entered the Daft Works at Greenville, N. J., as a student, and assisted in equipping the first electric cars of that company. The Volta and Ben Franklin. Subsequently he was engaged with the Mather Electrical Company, the Electric Accumulator Company, Augustus Noll & Company and the Edison Electric Illuminating Company in the positions of wireman and foreman, leaving the latter company in 1891 to go to Salvador, Central America, as constructing engineer for the Cia Luz Electrica de Santa Ana, in which capacity he designed and erected complete power and lighting plants in two cities, one steam, the other hydraulic. In 1893 he was appointed constructing engineer for the Edision General Electric Company and in the winter of that year designed and erected a complete steam and electric plant at Tampico, Mexico, for H. I. Skilton & Son, designing and installing a similar plant the following year for the same parties at Newton, N.J., and acting as superintendent for same for some months.

In 1896 Mr. Hines was appointed superintendent of construction for the Andrews, Ryan Company of Boston, for whom he designed and installed a number of important telephone exchanges. From 1898 to 1900 he was enaged in electricial work at Santiago, Manilla, etc., in connection with the Spanish-America war, and in the latter year received the appointment of constructing enginner for the General Electric Company, Schenectady, N. Y., for whom he installed several large plants, including a complete steam and electric installation at Banes, Cuba. In August, 1901, he became superintendent of the Lorain Steel Company, of Lorain, Ohio, remaining in that position until January, 1903. He was there given an opportunity for experimentation and invention, and as a result designed a magnetic separator for iron filings, an automatic pyrometer, and a system of indicators for regenerating furances, all of which inventions are now in use by the said company. He also holds a patent on a commutator brush holder and has patents pending for an arc lamp, electrical reduction process, electrical pyrometer, etc.



MR. C. H. HINES, M.I.E.E.,
Electrical Engineer for the Canadian Pacific Railway.

Mr. Hines was appointed electrical engineer for the Canadian Pacific Railway on February 1, 1903. He is at present installing an electric system of 5,000 horse power at their new Montreal shops and a still larger plant at Fort William. In addition he has charge of all the power and lighting circuits of the company, and it is understood that plans are under consideration for further extensive electrical installations at different points along the line of railway.

Mr. Hines is a well known writer on engineering subjects, having contributed papers on "Engineering Education;" "Alternating Versus Direct Current as Applied to the Steel Industry"; Application of Electricity in Steel and Iron Mills;" "Installation of Electrical Machinery in the Tropics;" "Machine Tool-Driving by Electricity;" "Tests of Machine Tools," etc. He is a member of the American Institute of Electrical Engineers and of the Canadian Electrical Association.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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CHARLES B. HUNT, Manager London Electric Co., London, Ont.
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Municipal Development. The Electric Energy Committee appointed by the Union of Municipalities interested in the question of an electric development at Niagara Falls, to be owned and operated by the various municipal corporations concerned, have concluded arrangements with Mr. R. A. Ross, of Messrs. Ross & Holgate, Montreal, for that gentleman to become the technical member of the Commission. Besides Mr. Ross, the personnel will be Messrs. Beck of London, Cockshutt of Brantford, Ellis of Toronto, and Snider of Waterloo, who are to be congratulated on having obtained the services of so able a man as Mr. Ross, and a Canadian at that. Unfortunately, it is too often considered necessary to go outside our borders for technical assistance on the more important Canadian questions which arise from time to time, which should make the Committee's action all the more gratifying to those interested in the policy of Canada for the Canadians. It is estimated that the investigation will cost in the neighborhood of $20,000, which if the size of the appropriation is any criterion by which to measure the results, should bring forth a classical report.

Electric Towing for Canals. When a country is young and natural wealth is to be found on every hand waiting only the application of mechanical processes to convert it into the more tangible form of coin of the realm, the methods involved are apt to be somewhat crude and wasteful. On the other hand, as time passes and competition becomes more in evidence, it is but natural that efforts should be made to improve the machinery and methods employed, so as to render them of the greatest possible efficiency. An interesting example of this is found in the case of canals. When first these were built the great majority were too small and shallow to allow the use of a self propelled boat owing to the wash and suction damaging the banks, and so recourse was had to animal traction. This method of towing has been in use for a great many years in all countries of the world, but its evident disadvantages in the shape of slowness, small power units, and costliness have led to many experiments aiming at a more satisfactory device. The latest of these, and those which give promise of a commercial system, two in number, naturally use electric motors. One is now in use by an operating company on the canal running through the Miami valley between Toledo and Cincinnati. This old waterway has for some time been practically abandoned, but now bids fair to become the scene of a heavy traffic. The Miami and Erie Canal Transportation Company has been organized to operate it electrically, and for this purpose has purchased seven Baldwin Westinghouse locomotives of the ordinary four wheeled type, and also some twenty barges. The former are each equipped with two 80 h.p. induction motors, geared to the axles similarly to a street car equipment, except that owing to the lowness of the maximum permissible speed, four miles per hour, there is a double instead of a single reduction gearing. The system is twenty-five cycle, three phase, using two trolley wires, with the rail as the third conductor. The pressure between these is in the neighborhood of 4,000 volts, the locomotives carrying transformers which reduce this to a potential suitable for the motors. Each locomotive is equipped with standard M.C.B. couplers for handling freight cars, together with hooks on the sides for the tow ropes. As the headroom under the various bridges is very limited, the machines are built as low as possible, in addition to which the track is dropped at some points. Even these did not give sufficient headroom in Cincinnati, where the bridges are very low, and so a special design of locomotive, abnormally flat, had to be built for this section. The complete canal is some 250 miles long, of which about 40 miles are at present in operation. The equipment now in use is said to be so satisfactory that it is being added to as fast as possible, in order to cope with the traffic offering. The other system has been in experimental use on the Erie canal at Schenectady. It differs from the one described above in that it is of the single rail type, a heavy structural steel track being provided, elevated on posts. The motors, one to each car, are of the direct current type, though there seems to be no special reason why an alternating equipment could not have been provided. The locomotives in this system are comparatively light, but obtain the requisite traction by the addition of a set of under-running wheels which are held up to the rails by springs. Further results of these two methods will be looked forward to with great interest, as if they should prove successful, there are many situations where their adoption would be of the greatest benefit.

Alternating Railway Motors.

We published last month a letter from Mr. F. H. Mason, United States Consul at Berlin, Germany, commenting upon the performance of a single phase railway motor which was being experimented with in that city. Since that issue went to press the Westinghouse Company are drawing special attention to the subject by announcing their readiness to contract for complete equipments of this type of apparatus. Not only do they claim it to be so perfected, and to have such advantages over direct current apparatus, as to render it the more preferable system of the two for new roads, but they make the further claim that in many cases the resultant economies would be sufficient to justify the superseding of 25 cycle rotary converters and direct current motors already in operation. That the subject is attracting a great deal of attention is further evidenced by the recent publication of two extremely interesting papers, one by Mr. Paul M. Lincoln, on the general comparisons between direct current and alternating single phase railway equipments, the other by Mr. Enrico Bignami, and dealing with a single phase traction motor recently designed by Mr. G. Finzi, of Milan, Italy. Mr. Lincoln, whose views may reasonably be taken to present those of the Westinghouse Company, with whom he is connected, enumerates the advantages of the alternating system as being in the main five in number, viz: The permissible increase of trolley voltages, the absence of rheostatic losses, the abolition of rotary converters, the avoidance of constant attention at the substations, and the removal of danger from electrolysis. On the other hand, there are certainly some inherent disadvantages, which Mr. Lincoln recites as consisting of greater weight, non-interchangability with other lines operating by direct current, increased voltage drops in the rails, the presence in the motors of an active and relatively large voltage between field turns, and the possibly disastrous results to telephone services in the neighborhood of the road. A most interesting conclusion which is drawn, after a detailed discussion of the above points, is that the alternating current traction motor of the future will probably be wound for comparatively low voltages, the trolley potential being reduced to the required pressure by transformers carried on the car. The paper then goes on to present and discuss a schedule giving a detail of the relative power consumptions, losses in transmissions and transformations, original costs, and operating accounts of the two systems. The figures are most complete, but cannot be reproduced here in detail. Suffice it to say that while the direct current equipments are some seventeen per cent. lighter, their power consumption is but ten per cent. less. The transmission and transformation losses, the two high tension lines being designed with the same percentage drop, and a 4/0 trolley being used for the alternating conductor, as against a 60-lb. third rail for the other, are more than twice as great in the latter case, notwithstanding that its cost is over 70 per cent. more. Further, the cost of the total direct current electrical equipment is approximately 25 per cent. greater than the alternating, while the yearly operating and maintenance accounts are some 7 per cent. more. Many of the alternating figures, are of course, estimates, but presumably are fair to that side of the case, in which event Mr. Lincoln makes out a remarkably strong argument for single phase traction.

Mr. Bignami's paper describing the Finzi motor states that it is an evolution of a type used extensively in the Italian navy for operating auxiliaries on battle ships. The principal characteristics are a multipolar laminated field, with longitudinal divisions to overcome the armature reaction, a small air gap, low armature speed, and a set of resistances between the armature windings and the commutator bars, to reduce the sparking. The machine is series wound, and was tested on a car from which a standard direct current motor, the G.E. 52 of the General Electric Company, had been removed for that purpose. The starting abilities and power consumption were found to compare most favorably with those of the other machine, as was also the commutation, which was well nigh perfect, there being no sparking except a little at the higher speeds.

From the foregoing it will be seen that apparently a commercial single phase traction motor is not only a possibility but an accomplished fact, and if such is the case it is to be expected that electric railroading will make even greater strides in the near future than it has in the past.

SPARKS.

Mr. Joseph Bargell, formerly of the Humber Light & Power Company, is arranging to develop a water power on the Credit river with the object of transmitting electric energy to manufacturers at Toronto Junction, New Toronto, etc.

The Erie & Ontario Development Company has just been chartered, with a capital of $96,000 and headquarters at Welland, Ont., to develop electric power and to utilize the fifteen and sixteen mile Creeks in Lincoln county, also to hold stock in or acquire the Jordan Light, Heat & Power Company. The promoters of the enterprise include Messrs. E. A. C. Pew and Andrew Nelson of Toronto.

COMMISSION TO INVESTIGATE ELECTRIC SMELTING.

The Dominion Government has taken an important step in the appointment of a Commission to go to Europe for the purpose of investigating the thermo-electric process for smelting iron ores and making steel. Canada possesses large areas of iron ore deposits which are now without commercial value owing to the lack of adjacent or available coal supplies. If it should be found that the numerous water powers throughout this country can be utilized for the purpose of generating electricity to be used in smelting ore it will open up an extensive field for profitable enterprise.

In Europe considerable progress has been made in the direction of electric smelting. There are five establishments where pig iron and steel are commercially produced, the firms being Kellar, Paris ; Harmets, St. Etienne, France ; Herault La Praz, France ; Captain Stassano, Turin, and Bennedicks, Gysinge, Sweden. The electric process produces a purer grade of pig iron and is especially suitable for the production of the different ferros which are used in the manufacture of steel, such as ferro-chrome, ferro-manganeze, ferro-sillicons, ferro-titanium, etc.

Mr. C. E. Brown.

No official announcement has been made as to the scope of the Commission, but it is understood that the experts will investigate and report on the quality of iron and steel produced, the cost of plant, and the general conditions under which profitable operation is possible. The inquiry may extend to the patents which have been issued and applied for and to all the details necessary to the adoption of electric processes in Canada.

The Commission appointed consisted of Dr. Haanel, Superintendent of Mines, assisted by Mr. Thomas Cote, and Mr. C. E. Brown, C. E., assistant works engineer of the Canadian General Electric Company, who will act as the electrical expert. A steel expert and a draughtsman to accompany the Commission are to be selected in Europe. Mr. Brown is thirty-five years of age, and a graduate in electrical engineering of the Iowa State College of Agriculture and Mechanical Arts. He took two terms of special work at Cornell University and in May, 1895, entered the testing department of the General Electric Company at Schenectady, N. Y., becoming foreman of the special testing department in June, 1896. From October, 1897, to February, 1899, he was engaged in designing work in the alternating current engineering department, resigning that position to become assistant works engineer for the Canadian General Electric Company. He is a member of the American Society of Mechanical Engineers and an Associate of the American Institute of Electrical Engineers.

THE CANADIAN PACIFIC RAILWAY SHOPS.

The new Canadian Pacific Railway shops at Montreal are designed and equipped for work which does not vary in character and is adapted for the tools installed. Most of the latter are used for services that vary so little that they can be most economically operated by the constant speed electric motors, which, in most cases, have been installed for them. The work in the machine shop has been divided into different general classes, such as wheel finishing, moving parts, like links, pistons, valves, etc., heavy turning, boring and planing. Brass finishing and other light work is done in the gallery and the erection of heavy parts is done in one of the side aisles. By this arrangement variable-speed-motors have been dispensed with and in a total of about 200 electric motors only 15 are of variable speed.

The system adopted is three-phase, 600 volt without transformers. This gives 550 volts at the motors and has the advantage of requiring about 10 per cent. less copper in the conductors. There are three 500 k.w., three-phase 600 volt, and one 375 k.w., alternating generators made by the Canadian General Electric Company, each of them driven by a separate direct-connected 750 h.p. engine of new type Corliss valve gear, making 150 r.p.m. and built by the Robb Engineering Company, Amherst, N.S. All motors, except those otherwise mentioned, are of from 5 to 50 h.p. of the induction type, three-phase, 550 volt machines made by the Canadian General Electric Company.

There is a standard three-phase switch-board with four generator distributing and exciter panels of the General Electric type. Outside wiring is done with overhead construction, bare copper main feeders running from roof to roof. In the building is a mixed system of open porcelain cleats and slow-burning water-proof wire on the ceilings, and Richmond conduits and rubber-covered wires on the side walls. Panel boxes are supplied, however, for every 10 k.w. of lighting and for every 100 h.p. of motor wire. There are 110 volt enclosed arc lamps of the Canadian General Electric make for shop illumination supplemented by standard 16 c.p. incandescent 110 volt lamps. There are approximately 400 arc lights and 3,800 incandescent lights in the yards and shops. In the passenger car shops the lights are spaced equi-distantly and low tension arc lamps are installed on account of their economy and better results for general illumination. In the yards there are 50 enclosed series arc lamps of high potential.

Yard transportation is provided by the 10-ton, 77 ft. span girder crane in the midway and the 10 ton, 57 feet span girder crane at right angles to it, which distribute materials back and forth between the iron foundry and machine shop, and are each operated by three direct-current, 220 volt motors of 25 h.p. for the hoist and 8 h.p. for traversing. There is also a yard transfer table operated by a 20 h.p., 550 volt motor. The shops will be equipped with a complete telephone system.

The electrical department of the Canadian Pacific Railway Company is installing all of the electrical wiring. The general office at the plant is wired throughout with conduit concealed work, and in every room there is a belt line of wire running around the oak walls near the ceiling behind oak moulding which can be removed and a light connected to it at any point without disturbing the line. In the shops the small machine tools are arranged in groups, which, in most instances, are operated by a motor seated on an overhead platform between the roof trusses.

At Fort William, Ont., the Canadian Pacific Railway have a still greater electric power installation under way. It is proposed to generate about 7,000 h.p., which will be used for the operation of grain elevators, etc. Bare copper will be used.

The above work, as well as many other important plans for the utilization of electric power along the line of the Canadian Pacific Railway, is being carried out under the direction of Mr. C. H. Hines, who has recently been appointed electrical engineer for the company.

LIGHTING AND VENTILATING OF PASSENGER CARS.

Messrs. H. Weston and C. J. Sewell, of the C. P. R. shops, Perth, Ont., have invented a system for lighting and ventilating passenger cars by means of electricity generated by power from the axles of the coach. The dynamo is operated by compressed air, causing the pulley on the dynamo to engage with that on the car axle. A pneumatic governor is used to regulate the pressure of air that will be required to run the dynamo. Storage batteries are used to furnish current when the dynamo is not generating.

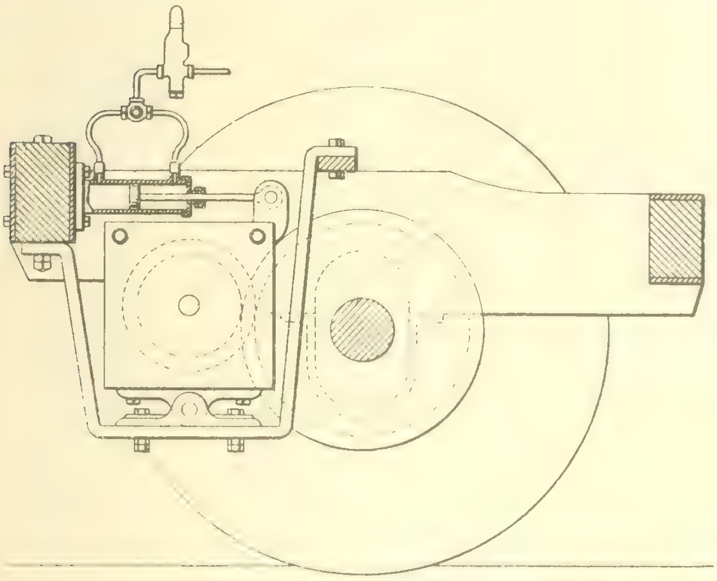


Fig. 1.—Side Elevation of Car Lighting System.

The system consists of wiring the car as in ordinary buildings. The dynamo is hung to the car truck on a pivot and connected with an air cylinder and piston. (See Fig. 1 and 2). The cylinder is connected at each end by rubber hose to supply air.

By applying compressed air at rear end of cylinder, the piston forces the dynamo pulley to engage with pulley on car axle. When the storage batteries are sufficiently charged the dynamo may be stopped by operating a three-way valve which is set in the floor of the car. The reverse operation will set the dynamo in motion. The compressed air is taken from the air signal pipe and passes through the pneumatic governor (Fig. 3), which regulates the pressure required to generate the necessary current.

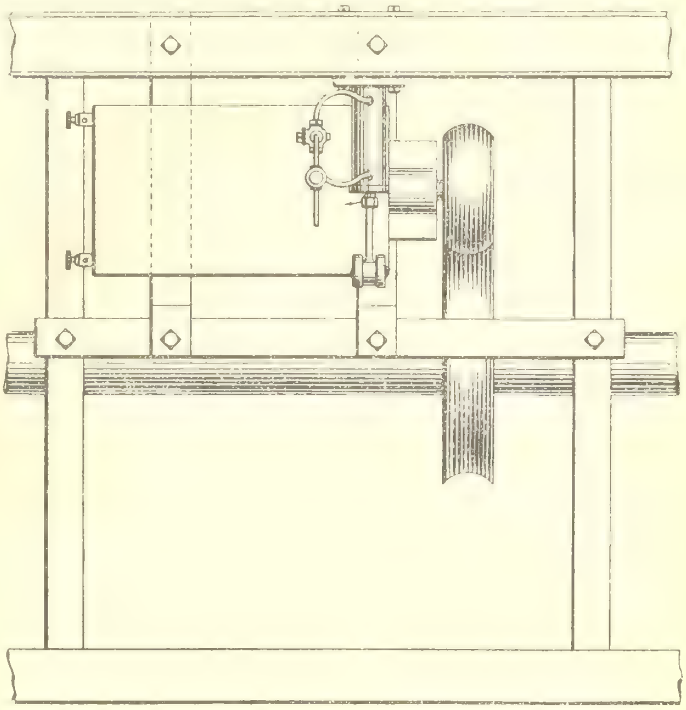


Fig. 2.—Top Elevation of Car Lighting System.

In case the speed of the car exceeds the maximum current of the dynamo, the friction pulley slips to reduce the power. The surplus current charges the storage batteries located under the car and is used to supply lights during stops.

A pole changer in the dynamo is used to change the polarity of the dynamo when the car runs in the reverse direction.

The current regulator is disposed of in this system on account of the friction having uniform tension regulated by the pneumatic governor.

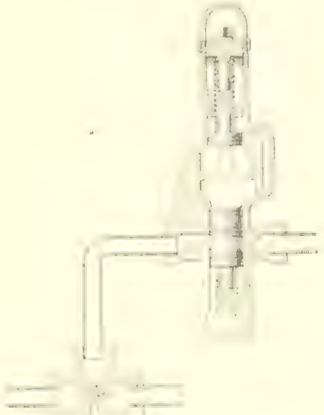


Fig. 3.—Pneumatic Governor.

The adjourned inquest into the death of John Agnew, which was caused by a boiler explosion in the factory of William Cane & Sons at Newmarket, Ont., was brought to a close on December 10. The jury in their verdict stated that they were unable from the evidence to arrive at a conclusion as to the cause of the explosion, but were of the opinion that the men in charge of the boilers were fully competent, and that no blame whatever attached to the management of the factory or any of their employees.

OPERATION OF ROTARY CONVERTERS.

The advent of the rotary converter presented to the station operator a new, interesting and sometimes dangerous piece of apparatus, probably the most delicate piece of electrical apparatus produced for light and power service, combining in one structure the qualities of an induction motor, synchronous motor, direct-current, alternating-current and double current generator. A rotary converter may be operated in any of these capacities with varying degrees of efficiency.

The machines are built to operate on two, three or six-phase circuits, and consist of a set of stationary pole pieces surrounding an armature of the ordinary closed-coil type connected to a commutator in the regular manner and tapped at the other end at equidistant intervals by straps connected to suitable slip rings. The number of taps per ring being equal to the number of pairs of poles, the speed of the machine is equal to the cycles per minute divided by the number of pairs of poles.

The armature reaction, though slight, consists of two effects, a direct-current reaction similar to that of a direct-current generator, tending to twist the field flux in the direction of rotation, and an alternating-current reaction similar to that of an induction motor, tending to twist the field flux in an opposite direction, providing the alternating currents are in phase with the impressed e.m.fs. The result of these reactions is a fairly even and uniform distribution of flux at all loads, permitting the direct-current brushes to be set permanently in the position where they will receive the commutated current from the coils when the coils are midway between the pole pieces.

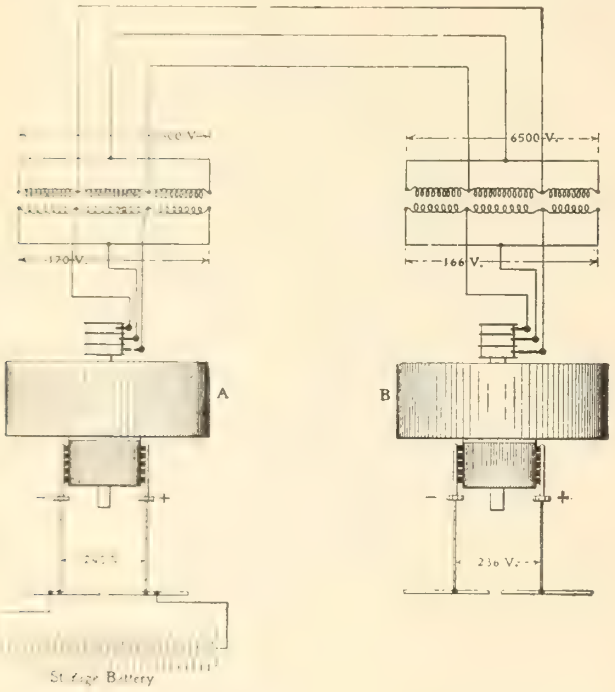


Diagram Showing Operation of Rotary Converters.

The operation and control of rotary converters operating in their natural capacity is the subject of this aricle, and as it requires greater care and judgment to run them from a secondary than from a prime mover, the writer will first consider the case of a 500-k.w. rotary driven by current from another 500-k.w. machine located in a station some miles distant from the receiving machine and connected to it by suitable transformers, cables, switches, etc. The connections are shown in the diagram. Converter, A is running as a direct-current motor and sendnig power out from the alternating side to the low-tension windings of transformers, a, where it is stepped up to any desired voltage and delivered to the line connected to transformers, b; this group reduces the voltage again for delivery to the alternating side of rotary converter, B. Passing through the armature of this machine it is converted and delivered at the commutator as direct current.

The speed of the transmitting converter is controlled directly by the field excitation, just as though it were a separately-excited, direct-current motor, but it may be indirectly affected by conditions existing on high tension lines or at the receiving end of the system. Any distortion of the phase angle of the line will affect the machines connected to it, the effect depending on the direction of the change; if it is in the direction of lead, the field flux of both machines will be increased and a corresponding decrease of speed will result; if it is in the direction of lag, an opposite effect is produced and the speed of both rotaries will increase. The variation of field flux is caused by the alternating current being out of phase with the e.m.fs. in the line, and this condition may be brought about by improper adjustment of the field excitation of the converter at the receiving end, by an inductive load suddenly thrown on the system, or by a short-circuit on the transmission line.

It follows, therefore, that sudden changes of field excitation are to be avoided at either end of the line, because the machines, when operating as described, will instantly respond to any variation of the phase difference between the line current and e.m.f., and if the variation is excessive they may in a few seconds reach a destructive speed resulting in a serious wreck. If the operator at the receiving end increases the field excitation of his machine, a corresponding change of phase difference in the direction of lead (or less lag) will result, and the speed of both rotaries will decrease; if on the other hand he decreases the field strength at the receiving end, the consequent alteration of phase difference will be in the direction of lag (or less lead), and the speed of both machines will increase. The system tends to operate with as good a power factor as possible under existing conditions, hence the automatic regulation of speed to conform to any variation of the phase angle. The danger of an inductive load caused by too weak a field at the receiving end is evident and to be avoided for reasons of safety as well as economy when operating rotaries from a secondary mover.

It will be noted from the characteristics of rotaries just described that an increase of inductance in the alternating-current circuit, causing the current to lag, will directly affect the speed of the machines on the system, and if excessive may cause a runaway. Therefore it is not a safe plan to start induction or synchronous motors or rotary converters from other rotary converters unless the transmitting machines are three or four times as large as the receiving machines, and are running under their strongest field excitation at the time, so that the leading effect of the strong fields will compensate for the lagging effect of the inductive load thrown on the system.

An open field circuit at either end of the line will cause a runaway if a single converter is operating on the transmitting nd; but if a battery of rotaries is in use on that end the operator ewill probably have time to increase the excitation of his machines sufficiently to prevent the other machines on the system from attaining a dangerous speed.

If a prime mover is in parallel on the system, loaded or unloaded, the danger of a runaway is almost eliminated, for the reason that the rotaries are electrically locked to the prime mover, the speed controller of which is a steam governor; therefore the speed of the system can only be varied by the steam supply to the engine, and not by any electrical effect, with the exception of a short circuit on the alternating current lines, causing a sharp and excessive drop of the primary voltage. In such a case, if the rotaries are operating on a system supplied with direct-current from engine-driven direct-current generators or from storage batteries, they will reverse and send out a volume of alternating current proportionate to the difference of voltage between the alternating and direct current sides of the machine; the heavy lagging currents resulting from the short-circuit being out of phase with the e.m.f. delivered at the slip rings, will tend to race the machines at a dangerous speed.

The protective devices usually installed on a system of rotary converters will, as a rule, open the lines within a safe limit; but if they do not operate within five seconds it is advisable to clear the machines by hand. The safety devices are electrically operated, and are installed on both alternating and direct-current sides of the apparatus to be protected. They consist of an oil break switch on the primary line in the sub-station, opened by either an overload or time limit relay, and a direct-current circuit breaker operated in conjunction with a second time limit reverse current relay on the direct-current side of the machine. A centrifugal device attached to the rotary converter shaft is used on some machines, an unsafe acceleration of speed causing it to open both the alternating and direct-current leads of the apparatus involved.

If the system is operating from a primary station, it will be found a safe plan to set the central station relays for about 100 per cent. overload and two seconds time limit, the alternating current relays at the sub-station for 75 per cent. overload and 1½ seconds time limit, and the direct-current reverse-current relay for 25 per cent. reverse load and 4 seconds time limit. If operating from secondary movers, adjustment for 75 per cent. overload and two seconds time limit will be found practical on the alternating current side. With safety devices set as described, a short-circuit on the line will be cleared at both ends in two seconds. Local trouble on the alternating side in the sub-station will be cleared from the line in 1½ seconds, and on the direct current end 2½ seconds later. A momentary surge of the engines will not throw the sub-stations off, as all automatic circuit breakers will hold for 1½ seconds.

The direct-current circuit-breakers, being set for two seconds longer than the line limit-switch, will cut out the machine if the local trouble continues after the line circuit-breakers have opened or failed to operate.

Clock-work and magnetic overload and relay devices do not clean themselves; they require blowing out, oiling and careful inspection at regular intervals to be operative when needed.

The conditions of the service in any particular plant determine the method of starting converters from a standstill. As mentioned in the early part of this article, a rotary may be operated either as a direct-current, induction or synchronous motor, and therefore may be started up in the same manner as any of these machines. The usual method is to start it from the direct-current side, as a direct-current motor, through a starting box which is cut out when the machine has attained sufficient speed to be cut in on the direct-current bus-bars; after the machine is switched from the starting box to the bus-bars, it is gradually brought to synchronism by weakening the field, and when in step, as indicated by lamps or a synchronizing voltmeter, it is cut in on the alternating-current side.

A second method is to speed up the machine on the direct current bus-bars to a speed a little above synchronism, then open the direct-current armature and field switches and close the alternating current switches, when the rotary will pull into step. Care must be used with this method to open the direct-current armature switch first; if the field switch is opened first a dangerous speed may be reached before the armature switch can be pulled.

A third method is to start the machine from the alternating-current side. With the direct-current armature and field switches open, the alternating switches are closed, and the machine slowly builds up to synchronism; when a fair speed has been reached the field switch is closed and the machine is ready for load. On rotaries of over 100 kilowatts capacity, a special switch is mounted for closing the field circuit when starting in this manner; it is called a "break-up" switch, and its function is to divide the field winding into several sections, so that when the switch is opened the reactive kick is greatly reduced, and when it is closed uniform excitation of all the poles is obtained at the same instant.

A fourth method is to start the engine-driven alternator and the rotary from a standstill. With all switches closed between the alternator and the converter, the field circuit of the converter open and minimum excitation of generator fields, if the engine is started slowly the rotary will start up with the alternator; when the rotary armature has made several revolutions, the field switch should be closed, and when the engine has reached full speed, balance across the direct-current switches and switch it to the direct-current bus-bars.

If a rotary is self-exciting it will sometimes, when started from the alternating side as described in the third and fourth methods, build up reversed on the direct-current side. This element of delay may be obviated by connecting a voltmeter to the direct-current terminals; as the machine builds up, the voltmeter needle will slowly swing from zero to a point well up on the scale, and if after the machine has reached a fair speed the field switch is closed at an instant when the needle is at the highest point of its swing, the machine will always build up with correct polarity. The polarity of separately excited machines is fixed, of course, and there is no danger of building up reversed.--W. T. Fernandez, in American Electrician.

The Ontario Traction Company, Limited, has been incorporated by Messrs. C. M. Walker, E. F. Ladore and J. H. Coburn, of Walkerville, and F. M. Ohl and W. F. Brown, of Toronto. The company purpose to construct a street railway in the town of Walkerville and extending for a distance not exceeding one and one-half miles in the city of Windsor and a similar distance in the township of Sandwich East.

WORLD'S RECORD ESTABLISHED.

Mr. Fred B. Whitney, Clerk to the Committee of Naval Affairs, and Mr. Henry C. Porter established the world's record at Washington, D. C., December 23 for endurance run at highest long distance speed of an electric stanhope upon a single charge of storage battery. Mr. A. L. Cline, president of the local automobile association, officiated as referee. They started Tuesday night at 7.05 from the Dewey Hotel in an electric stanhope equipped with a 570 lb. storage battery and ran upon the streets of Washington until five in the morning, when the machine collided with a heavy covered wagon and was badly disabled. A distance of 107.4 miles was made in the actual time of nine hours and twelve minutes, or about twelve miles per hour. The longest runs without stop were 31, 23 and 21 miles.

At 2 p.m. Wednesday, after temporary repairs were made, the run was resumed and 13.8 miles made in one hour and twenty minutes under difficulties of disabled machine. The machine was run to its garage under its own power and showed a voltage of 1.85 per cell, and without accident many more miles might have been made. The total distance run was 121.2 miles in 10 hours 32 minutes, or 12 miles per hour. This established a world's record for long distance run upon a single charge at rate of twelve miles per hour and raises the long distance rate per hour by one mile. This record was made with a battery made from material entirely new to the battery industry.

The world's record at 11 miles per hour for 151 miles was made in July, 1902, at Cleveland. The world's record at 10 miles per hour for 187 miles was made at Chicago by Mr. F. C. Phillips and Mr. Porter.

Mr. Whitney believes a practical hundred mile machine upon a single charge of the battery is a near possibility and believes his proposition will be demonstrated as soon as the public desires a long distance electric upon lines which he holds are economical and mechanically possible.

LEGAL DECISIONS.

The Ottawa Electric Company lost their action in the Divisional Court against Henry Birks. The company alleged that Birks had agreed to take electric lighting for their premises from the company for one year, and, before completing the contract, he had cut the wires and taken electricity from another company. The judges of the Divisional Court held that the quantity of electricity taken was to be paid for by meter, and that the only obligation the defendants had assumed by the contract was to take a quantity amounting to not less than $12 worth. The judgment of the County Court in favor of the Ottawa Electric Company was reversed and the defendants' appeal allowed.

Ahearn & Soper as. Randall.—Judgment was given by the Court of Appeal at Toronto last month in the case of Randal against Ahearn & Soper of Ottawa. This was an appeal by the defendants from the judgment of a divisional court dismissing a motion to enter non-suit or judgment for the defendant after disagreement and discharge of the jury at the trial. The judgment of the court of appeal was that the action cannot be maintained. The plantiff was engaged by the Ottawa Electric Company to do work in connection with the wiring for the illuminations for the visit of the Duke and Duchess of York to the Capital. He seems to have placed a transformer on a pole of the Great North Western Telegraph Company without warrant. Ahearn & Soper's men had placed on the same pole wires connected with the illuminations. The allegation was that the wires were so negligently affixed and so dangerous that Randall came in contact with them and fell from the pole. The judgment holds that the plaintiff showed no reason for attaching blame to Ahearn & Soper. He had no right to be there, and Ahearn & Soper had no reason to believe that he would be there, and so were not bound to be cautious as regard the plaintiff. The appeal was therefore allowed and the action dismissed.

A project is on foot to build an electric railway from Murray Bay to St. Irenee, Que., with branches to other points.

The Backus-Brooks syndicate is announced to have concluded negotiations with the Ontario Government which will result in the immediate development of the water power at Fort Frances, Ont. The initial work will be the building of a large dam and it is expected that about 6,000 horse power will be developed. It is stipulated that the power house shall be built on the Canadian side.

MR. P. G. GOSSLER.

Mr. P. G. Gossler, general superintendent of the Montreal Light, Heat & Power Company, has tendered his resignation, which will take effect on May 1st next. It is understood that Mr. Gossler has accepted an appointment as general manager of the operating department of Messrs. J. G. White & Company, electrical engineers and contractors of New York city.

Philip Green Gossler is one of the youngest of the many young men filling positions of great responsibility in the electrical field. He was born in August, 1870, at Columbia, Lancaster county, Pa., and was graduated as electrical and mechanical engineer from the Pennsylvania State College in 1890, when he was only 20 years of age. In the following year he joined the staff of the United Electric and Power Company, of New York City. At that time the business of the company consisted of the operation of the arc-lighting plant and system of the United States Illuminating Company and the arc-lighting plant and system of the Brush Electric Illuminating Company, to which had but recently been added incandescent lighting by alternating current. Besides generating stations established especially for the latter service, several of the stations of the two companies were remodelled and re-constructed to provide, in addition to their original service, a system of alternating current incandescent lighting service. At just about that time also was begun the distribution of current for arc and incandescent lighting by cables in underground conduits. Mr. Gossler was engaged in the most intimate and practical way in all the work attendant upon such remodelling and reconstruction, in new installations for new class of service, and in the selection, testing and placing of underground cables, then a new art. Amid all this varied practical work he did not overlook or avoid original investigation and work of precision for commercial purposes. In 1892 he conducted a series of most complete tests of incandescent lamps.

MR. P. G. GOSSLER.

In May, 1895, Mr. Gossler accepted the position of general superintendent and electrical engineer for the Royal Electric Company of Montreal, in which capacity he was closely associated with the installation and operation of the Chambly water power plant. The construction of the transmission line was done under his immediate supervision and is notable as an example of best methods. He also undertook and carried to successful completion the reconstruction and extension of the generating and distributing plant of the Royal Electric Company in Montreal. The business of the Royal Electric Company, Imperial Electric Company, Montreal and St. Lawrence Power Company, and the Montreal Gas Company was subsequently taken over by the Montreal Light, Heat & Power Company as one organization, which company about one year ago absorbed the Lachine Rapids Hydraulic & Land Company. The services of Mr. Gossler were retained and the scope and extent of the work under his charge was naturally greatly increased. His experience, ability and characteristic energy were equal to the occasion, however, and the result of his management was such as to give general satisfaction.

Mr. A. D. Adams, writing in the Electrical World regarding the utilization of electric power in Montreal, says:

"In an area about 14 miles long and of an average width of 3 or 4 miles on the Montreal sides of the St. Lawrence, and in a strip about one mile wide and four miles long on the south shore, there are 11,152 customers using commercial arc and incandescent lamps, and 870 customers using motors, besides fifteen cities, towns and villages, including Montreal, whose street lighting calls for 1717 arc and 577 incandescent lamps. The commercial lighting service has connected with it 299,900 incandescent lamps, 1,514 arc lamps and 405 fans, heaters, etc. The power service has 870 customers, whose 1,109 motors have an aggregate capacity of 19,172 horse-power." Mr. Adams, who writes as an expert, describes at much length the various stations of the companies which are combined in the Montreal Light, Heat and Power corporation, as being in design and equipment among the best that have been created and an evidence of the capacity of Mr. P. G. Gossler. He adds that "the showing of 46 per cent. of the gross earnings as net income has been made through good engineeirng."

Mr. Gossler is a member of the American Institute of Electrical Engineers, and in June last was elected president of the Canadian Electrical Association, to which association he has contributed some valuable papers.

Mr. Gossler's many friends in the electrical field will deeply regret his departure from Canada, but all will join in wishing him the abundant success which he so well deserves.

Mr. J. D. MacDonald, of the West Kootenay Power & Light Company, has just installed an electric lighting system at Fernie, B. C. He installed two 3,000-light alternators at Coal Creek, five miles from Fernie, built lines connecting the mines with the city, wired the city, and started the lights in operation. Next spring a 3,000-light plant will be installed at Morrissey Mines.

Plans are said to have been completed for the construction of an electric railway from Montreal to Ottawa, with a number of branch lines to adjacent points along the line. Surveys have been made and it is estimated that the road can be constructed at an average cost of from $10,000 to $13,000 a mile. The president of the company is Col. McMullen, of New York, and the directorate is composed of Messrs. F.D. Monk, M.P., T. W. Raphael, Thomas Christie, M.P., J. A. Ethier, M.P., J. E. Leonard, M.P. and Thomas Gauthier.

QUESTIONS AND ANSWERS

1. Why will a dynamo build up only with the fields connected one way?

ANS.—The best way to understand this matter is to consider a machine just being started, in which it is evident that the combination of the direction of rotation, the armature and field connections, and the direction of flow of the residual magnetism will produce a slight voltage at the terminals of the field coils. This in turn causes a small current to pass through them and this tends to produce a further flow of magnetism through the fields and armature. If this additional flux flows in the same direction as the residual magnetism it is evident that the action is cumulative and that the result will be the desired building up of the generator. On the other hand, if the result of the various conditions at the time of starting should be such as to produce a flux which is opposite in direction to the residual magnetism, it is evident that the latter will be decreased in value. This again means a decrease in the opposing flux, the two actions going on until there is virtually no flux flowing. The machine then stays dead until either the field connection or the direction of rotation are reversed.

2. Can you explain to me what is the Turret system of control? How does it work?

ANS.—This plan of controlling direct current motors, designed originally for handling the motors operating the machinery in the turrets of battle ships, whence the name "Turret," consists in the somewhat novel means employed to vary the potential applied to the motor, and thus the speed. The change in voltage is ordinarily obtained by inserting more or less resistance into the circuit, but when the Turret method is employed the field of the generator is varied so as to produce a higher or lower potential as desired, the armature of the motor being connected directly to it without any rheostats whatever. This means that there must be a separate generator for each motor, or for each group of motors the speeds of which are to be varied simultaneously. The generator is usually separately excited, as is also the motor if shunt wound. If it is series wound there is, of course, no necessity for this. This method is also known as the Leonard system, after its designer, Mr. H. Ward Leonard.

3. What is a static transformer?

ANS.—A static transformer or converter is the ordinary transformer used everywhere on poles, in power houses, etc., for changing any given voltage to any other desired, or, when more than one transformer is available, for altering the number of phases if such is required. The adjective static is used only when it is desired to distinguish between stationary and moving apparatus, such as rotary converters or motor generators, though it is questionable as to whether or no it is desirable, as it is often confounded with the word electrostatic, which concerns an entirely different phenomenon.

4. Show how to arrange the wiring of five 110 volt lamps now connected in series so that they may be connected in multiple to 110 volt D.C. circuit and either connection may be used when required.

ANS.—To arrange five lamps so that they may be used either five in series on 550 volts, or in parallel on 110 volts, would be a rather cumbersome proposition, in that it would require five double-pole double-throw switches, all of which would have to be thrown before the lamps would light off 550 volts, or else one 10 pole double-throw switch, in this case a commercial impossibility. Besides this you would have to bring lines from each separate lamp to the switches or switch. Would it not be better to wire up five more lamps in multiple, controlled by one switch off the 110 volt circuit, the present five remaining as they are in series on 550 volts, or else rewire them to the ordinary multiple connection and operate them by a double-pole double-throw switch from either the secondary of a 550 to 110 transformer, the primary of which is on the alternating circuit, or, with the switch throw the other way, direct from the 110 volt exciter circuit.

5. When starting an induction motor with an auto-transformer or compensator, is the current between it and the motor greater or less than that taken from the line?

ANS.—The relation between these two currents depends on whether or no the voltage delivered by the starter to the motor is greater or less than the line potential. If it is greater the motor current will be smaller than that taken from the line, if the potential is less the current will be greater, in fact they will vary almost in inverse proportion to each other. That this must be so will be evident when you reflect that the compensator, not being a moving piece of apparatus, cannot store energy, and that therefore its output must be the same as the input minus say 10 per cent. for losses in it. This means, therefore, that if the secondary or motor voltage is half that of the line, the current on that side must be roughly twice the other, with one-quarter of the voltage, four times the current and so on.

6. Does coal when stored for any length of time lose any of its heating power? What is the relation between the heating power of coal and wood?

ANS.—When coal is exposed to the atmosphere there is a constant chemical action going on, which, of course, is slow but which nevertheless will eventually produce quite appreciable results, depending on the time, the kind of atmosphere concerned, and the composition of the coal. The principle products of the change, the carbon of the coal uniting with the oxygen of the air, are carbon dioxide and hydrogen, the latter also uniting with the oxygen to form water. The process is, of course, accompanied by considerable heat, which is the cause of the spontaneous combustion of coal piles, a difficulty often encountered when storing large quantities. In steam boiler tests a given weight of wood is assumed to have but 40 per cent. of the heating power of the same weight of coal, the value of equal weights of woods of all kinds being practically the same. Thus, to find the given wood equivalent of a ton of coal, the wood being measured in cords, it will be necessary also to know the weight of the wood per cord. This naturally varies for different kinds, the two extremes being perhaps pine, averaging say 2,000 lbs. per. cord, and hickory or hard maple, which will run about 4,500 lbs.

THE LATE MR. F. T. WILKES.

Suddenly on December 17th death summoned Mr. Frederick T. Wilkes, secretary-treasurer of the Waterous Engine Works Company, of Brantford, Ont. He had not even complained of feeling unwell, but as he was walking home he was seized with a fainting spell and expired before medical assistance could reach him. Deceased was in his 56th year, and had apparenly been in the best of health up to the time of his death. He was a well-known figure of local business circles, was particularly active, and a man of determination and courage. Born in Owen Sound in 1847, he was the son of Judge Wilkes. He went to Brantford some thirty-five years ago, entering the employ of the Waterous Company. Here he gained ni a large measure the practical business ability which in after years contributed so greatly to his success as controller of enormous industrial interests.

Mr. Wilkes never took an active part in public life, but was a careful student of the questions of the day that affected the welfare of the country. Mrs. Wilkes and three sons survive him.

HIGH TENSION ELECTRIC SHOCKS.

Death from electric shocks does not necessarily follow exposure to high voltages, but depends upon many conditions, and oftentimes when the conditions appear to indicate a fatal shock death does not occur.

Some remarkable instances are on record of survival after severe shock. One of these is of a man who had been submitted to a pressure of 5,500 volts. The case is described in a medical journal. The left hand, left side of the body, feet and shoes appeared to have received the greatest part of the current on its way to earth. Flames and light were given off trom the man, who remained about a minute half hanging and half suported from the wire till he was torn from contact by two of his companions. The local changes were on the volar part of the left hand, a dry, hard, charred surface, beneath which was a white layer of insensitive tissue. The same condition was met with on the dorsum of the fingers and ulnar side of the hand. When the charred covering was removed the cutis was blanched and painless, giving out no blood when pricked with a sharp instrument. This condition extended to the elbow, diminishing higher up to reddening and swelling. The toes and skin of the feet, where the current left the body, were in a white corrugated condition. The patient, after a few days of illness, recovered.

Perhaps one of the most remarkable cases on record is one described in the Electrical Review of London. The accident happened to an Italian blacksmith named Archimedi Lazzari from Mantova, Italy, while at work upon the Canadian-American hydraulic plant at Parnahyba, State of Sao Paulo, Brazil.

It was decided to change all the iron frame work behind the high tension board to wood. The buses had been divided into halves preparatory to being connected to their respective switches. There are two separate sets of bus bars, one above the other; either can carry the entire load, so that as the work proceeded the current was changed alternately from one set to the other, thus avoiding the necessity of working on live wires. Every precaution had been taken against accidents, and, in fact, it was overzeal to be cautious which caused the mishap. The buses being divided and the work being carried on upon the dead section, one of the operators, Thomas W. Bevan, jr., son of the power house superintendent, went over to work near the live half. Archimedi, wishing to warn him of his danger, took hold of young Bevan's wrist and leaned forward to speak with him ; at the same time he had his foot against an anchor bolt of the iron framework which had just been taken down. This bolt was cemented on to the floor of the gallery (the high tension board being on the gallery), the latter being made of steel rails with brickwork arching between the rails. Archimedi leaned over too far and came too near one of the 24,000 volt bare copper wires, which was one of the secondary leads off the main transformers to the high tension board. Immediately the current jumped on to his shoulder, passing through his body and out at his feet on to the anchor bolt. Both Archimedi and Young Bevan remained transfixed, while the older Bevan, thinking it was his son who was on the wire, leaped into the air (in order to disconnect himself from the ground) and plunged against his son. The shock pulled both men off the wire, and Archimedi loosened Bevan's wrist, only to fall near the wire again, in almost identically the same position as before, only this time the whole current was passing through his own body, not as before, when a portion must have been shunted through young Bevan. Mr. Bevan, the father, who was thrown violently on the floor, tried to kick Archimedi's feet from under him, only to find that every time he (Mr. Bevan) touched the stricken man's foot, his own legs were shot back with terrific force. Archimedi remained thus until the power was taken off. He must have been fully half a minute under the action of the current. He claims to have been conscious all the time and says that he felt nothing. In fact, he was able to describe exactly what occurred, and says he felt the power taken off the first time, and then come on again, as he fell the second time near the wire. On the power being taken off he immediately became unconscious, and his mouth had to be opened with the end of a file and a piece of wood put between his teeth to keep them apart, while his arms and legs were being worked so as to produce artificial respiration. In a little over 10 minutes Archimedi was able to walk about on a man's arm. He felt sick and had fearful burns on his shoulder and his foot, but after about six weeks' absence he came back to work and has not missed a day since. Both the Bevans suffered nothing greater than little burns over the body wherever the current came in contact.

All the men present are willing to vouch as to the place in which Archimedi suffered the shock, namely, on the high tension gallery, and there are no wires there except bare copper wires, all under a pressure of 24,000 volts.

The Review correspondent, who was present (and who at once rushed to the switchboard under the gallery and pulled out the main exciter switches), observed a heavy arc between Archimedi's foot and the anchor bolt, and young Bevan saw a similar arc formed between his shoulder and the wire. There was apparently, therefore, no actual contact with the wires, and owing to the high resistance of the arcs the current was greatly reduced in volume. Just why death did not occur is hard to determine. The probable reason is that, although the man was subjected to a very high voltage, very little current passed through his body, due to its great resistance and also the resistance of the two arcs between his body and the wire and bolt.

Another reason set forth is that, as the man had been working vigorously just before the accident, his clothes were saturated with perspiration and a large part of the current was shunted around him in that way.—Western Electrican.

OBITUARY.

The Late Mr. Frenyear.

Mr. Thomas Cyprian Frenyear, sales manager of the new Canadian Westinghouse Company, died of typhoid fever at Fort William, Canada, on December 10. He was a man of exemplary life, unusual business judgment and ability, and was remarkable for the clearness and force of his ideas. As an electrical engineer he was a good adviser. His is the first death in nearly five years among the higher officials of the Westinghouse Electric Company.

Mr. Frenyear was the son of the Rev. T. C. Frenyear and was born on March 16, 1865, at Middletown, Vermont. He began his business career before he was fifteen years old, in the office of the Boston Electric Company, where an uncle, Mr. W. R. Nutting, was manager. While there he entered the Latin School, doing his studying at night. From there he entered Phillips Exeter Academy, paying his way by keeping a book store for students. He was graduated in 1885. He entered Harvard that autumn, but could not spare time from business to continue the course. He afterward entered the Boston University, but a business reverse put an end to his efforts to gain a collegiate degree. For several years after that he was in the employ of the Thomson-Houston and Brush Electric Companies as a salesman, with headquarters at Buffalo. From 1892 to 1895 he was superintendent of the Cayadutta Electric Railroad. In the fall of 1895 he entered the employ of the Westinghouse Electric & Manufacturing Company. He was connected with the sales office of that company until November 1, 1903, when he was placed in charge of the sales department of the new Canadian Company, with headquarters in Toronto.

Mr. Frenyear was married to Miss Emma L. Chase, of Exeter, on June 28, 1893. Mrs. Frenyear and three children survive him. He was a deacon and trustee of the Delaware Avenue Baptist Church of Buffalo, and had been superintendent of the Sunday School.

In announcing the death to the officials of the Westinghouse Company, Vice-President Taylor said: "The Management desires to place on record its thorough appreciation of his able and loyal service and of the loss to the Westinghouse interests by the untimely removal of a young and zealous official whose future seemed so full of promise."

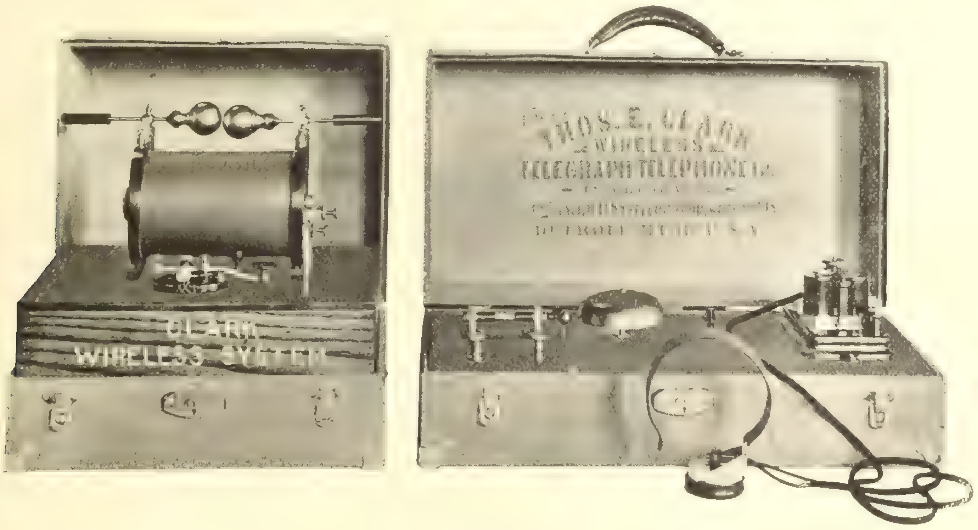
WIRELESS TELEGRAPH INSTRUMENTS.

By Ackland Stiling.

The accompaning illustrations show a set of wireless telegraph instruments made by the Thos. E. Clark Wireless Telegraph-Telephony Company, of Detroit, Mich. Fig. 1 is a transmitting instrument consisting of a transmitting transformer, dry batteries, telegraph key and adjustable spheres or spark gap. As will be seen, the parts are tastefully arranged and are mounted on a piano-finished, hardwood base. All the unsightly parts and electrical connections are concealed, the spark gap, sphere, coil proper and key only being exposed to view. The dry batteries snpplying the energy to the coil or transformer are located in the lower part of the case.

The transmitting coil is of the Clark high frequency transforming type, with primary and secondary, the insulating material being of the highest grade. The core is so constructed as to prevent the usual loss through eddy currents. The condensers are especially well insulated. The vibrator seen at the end is fatsened securely to the coil head and is supplied with heavy platinum contracts; it is so constructed that the adjustment, once made, is constant.

The coilis mounted on hard rubber brackets with polished heads. The secondaries terminate at the tops of the head ends. The telegraph key is connected in the battery circuit, and when used by the operator in transmitting messages in the Morse Code of dots and dashes, it excites the primary of the coil or transformer, there by causing rapid current alternations in the secondary, which gives rise to discharges at the sphere gap. The spheres are mounted on pillars of polished insulating material. The secondary of the coil is connected, as well as the aerial capacity, with a ground on a gas or water pipe. The aerial wire is otherwise insulated from the ground by means of a bamboo fish pole, a hammock or wire cord suspended by means of brass hooks holding the bamboo.



Set of Wireless Telegraph Instruments.

The receiving instrument (Fig. 2) is made up of the following parts, mounted on an oak removable base: An adjustable Clark sealed coherer with a neat receiving stand or clip, which supports the coherer and acts as connecting or disconnecting switch as well; a special wound split core relay of the Clark type, with automatic tapper; and condenser and shunt coils. The batteries for the receiving and tapper circuit as well as the shunt coils, condensers and tapper are all concealed in the case underneath the shelf panel; the relay head band receiver attachment, gong, coherer and binding posts for aerial and ground connections, together with circuit switches, being the only parts visible.

Both instrument may be transported as easily as dress suit case, being very compactly enclosed in a drab color case. A tape writing device can be used instead of the microphonic receiver if desired; with some practice, however, messages can be received faster with the latter.

HEATING VALUE OF ACETYLENE AND COAL GAS.

The heat units developed per cubic foot of acetylene and coal gas are 1850 and 630, respectively. One quart of water was brought to boiling from 50° Fahr. in 8½ minutes with acetylene and in 10½ minutes with coal gas; the burner of the former consuming two cubic feet of gas per hour, while that of the latter consumed 16 cubic feet per hour.

UTILIZATION OF WASTE GAS.

Henry G. Morris, in a paper on the gaseous fuel problem read before the Engineers' Club of Philadelphia, says "the rapidly increasing use of gas engines of high powers is an evidence of the desirability from an economical standpoint of the use of gaseous fuel, opening up a wide field of problems which the engineer will be called upon to solve in the near future. As an example, it is probable that fully 20,000 tons of coke is made per day in the Beehive Ovens, within a short distance of the line of the Pennsylvania Railroad between Altoona and Pittsburg, from which about 100,000,000 cubic feet of gas is discharged into the air or wasted, which if converted into power through gas engines would represent 5,000,000 horse-power-hours, or the effort of about 104 gas engines of 2,000 horse-power each."

NEW MONTREAL BRANCH.

For the better distribution of its products, for which there is a steadily increasing demand, the Dodge Manufacturing Company, of Toronto, Limited, manufacturers of the celebrate Dodge pulleys and many other lines now prominently on the market, will open commodious quarters at 419 st. James Street, Montreal. This will be welcome news to many users of transmission machinery in Montreal and the east, as the Dodge Company's well known reputation for carrying full and comprehensive stocks of their various lines and for making prompt shipments has always been appreciated both by the trade and the users. A competent staff will have the new branch in complete running order by January 15th.

The controlling interest in the Stave Lake Power Company of Vancouver, B. C., has been purchased by foreign capital, represented by Mr. Thomas Wilson, of Vancouver. It is understood that the consideration was about $32,500. The announced intention of the new owners is to develop the power immediately and to furnish light and power in Vancouver in competition with the British Columbia Elentric Railway Company.

FRICTION OF BALL BEARINGS.

After many tests of ball bearings, Mr. J. Golden found that the coefficient of friction was 0.00475 or less than one-half of one per cent.; though in a few of the tests the figure was found to slightly exceed one-half of one per cent. The friction was slightly greater with the smaller balls and at the higher speeds. The formula deduced was got from so small a range in the sizes of the balls, and the degree of hardness in both balls and races was so nearly uniform in all those used, that it is not given to be used as a general formula, and only for what it may be worth after comparison with other formulae.

Let the diameters be taken in inches, and the load in pounds then

D = diameter of the path of the balls on the races.
d = diameter of the balls.
L = load.
F = friction.

$$F = L\left(0.005 + \frac{0.001}{d} + 0.005\,D\right).$$

The balls and races to be of steel and to be accurately ground, and as hard as possible in temper.

The Grand Mere Electric Company, of Grand Mere, Que., has been incorporated.

NEW TELEPHONE LINE

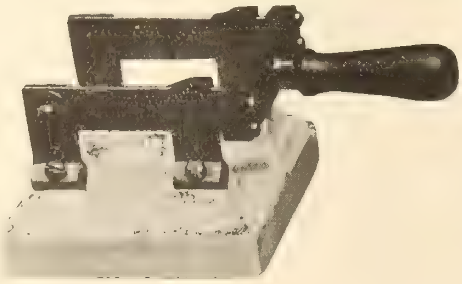
A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates:

Port Rowan	50c.
St. Williams	50c.
Vittoria	40c.

THE BELL TELEPHONE CO. OF CANADA

Our Latest 25 Amp. D.P. Porcelain Base

The Cheapest and Best



All Particulars for the Asking

The HILL ELECTRIC SWITCH CO., Limited

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PERSONAL.

Mr. N. F. Braden has been appointed sales manager for the Canadian Westinghouse Company as successor to the late Mr. T. C. Frenyear.

Mr. Francis V. Greene, of New York City, has been appointed manager of the Ontario Power Company of Niagara Falls, Ont. His headquarters will be in Buffalo.

Mr. Harry S. Williams, son of Mr. William Williams, manager of the Sarnia Gas & Electric Light Company, has been engaged to superintend the municipal gas plant at Guelph. Mr. Williams has been in the employ of the Sarnia Gas Company for over six years, and prior to his departure his fellow employees presented him with a handsome gold watch and chain.

The following new appointments are announced by the Canadian Pacific Telegraph s: Mr. F. T. Jennings, formerly chief operator and circuit manager, to be inspector of telegraphs, eastern division ; Mr. Harry Bott, formerly wire chief operator, to be chief operator and circuit manager ; Mr. F. N. J. Caisse becomes wire chief, J. Mitchell night chief, and A. Benny assistant night chief at Montreal.

The resistance of the fly-wheels of two 450-horse-power engines at 95 revolutions per minute, was reduced over 25 per cent. by covering their faces with smooth sheet metal, during tests at Nuremburg. The arms of the wheels were a double T. with central web parallel to center line of shaft.

HOW TO CLEAN BELTING.

A belt dressing company submits the following as the best and proper way of cleaning a leather belt. It may seem simple, but it is safe and effective, as has been proven by many people who have thus restored old and dirty belting which had become almost or quite unfit for use.

Coil the belt loosely and place it on edge in a tank in which it may be covered with naphtha ; a half barrel makes a good receptacle, but something with a tight cover would save the loss by evaporation. Put in enough naphtha to cover the belt completely and allow it to remain for ten or twelve hours ; then turn the belt over, standing it upon the other edge. The vertical position of the belt surfaces allows the dirt to settle to the bottom of the receptacle as it is washed out, and permits the naphtha to get at all the parts.

After the belt has remained in the naphtha another ten or twelve hours, or until sufficiently clean, raise it and allow the naphtha to drip back into the tank. Then lay the belt flat, streching or shaking it until almost dry. You will find that the naphtha will not affect the leather nor the cement in the center of the belt, but may open the joints at the edges; in which case the old cement should be scraped off and the edges recemented. Your belt man will known how to do this.

The belt will now be somewhat hard, and should be treated with a reliable belt dressing before being replaced on the pulleys.

COMBUSTION IN BOILERS.

Most steam engineering specialists hold the opinion that with bituminous coal and hand firing the combustion in a boiler furnace is incomplete unless provision is made, by either the arrangement of the boiler or the regulation of the system of firing, to introduce a sufficient amount of air into the mass of burning gases. There have been many demonstrations of the favorable result of supplying air properly distributed through the gases, in the case of return tubular boilers. It seems to make little difference how the air is admitted, whether it is hot or cold, or whether the device employed for admission is simple or complicated, the efficiency of combustion is improved and there is an increase in the economy of the boiler. For example, the efficiency of a 60-inch return tubular boiler was increased no less than 8 per cent. by fitting it with appliances for introducing air at the bridge wall, the supply being first carried through pipes extending back and forth at the point of its discharge. In another case there was a gain of 9 per cent. produced by introducing air by means of a checkerwork in the combustion chamber.

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Our New Works now being in full running order we are prepared to fill all orders for **Gasoline Engines, Special Machinery** and all kinds of rough or finished Iron or Brass Castings. Get our quotations on **Grate Bars, Boiler Fronts,** etc., etc. Wholesale and Retail. Head Office, THORNBURY, ONT.

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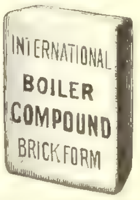

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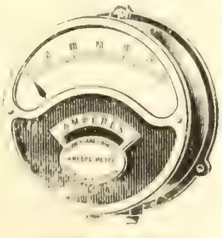

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SPARKS.

The town council of Ingersoll, Ont., are in favor of taking over the electric light and gas plants by which the town is now lighted.

The National Manufacturing Company are desirous of building works at Pembroke, Ont., for the manufacture of windmills and gasoline engines.

Mr. Hoyt, manager of the Nova Scotia Telephone Company, of Amherst, N. S., has just completed the installation of a telephone system for the Maritime Coal Company at Chignecto Mines.

Mr. Vandervoort has made a proposition to supply Pembroke, Ont., with electric power from Petewawa. The figures asked are $25 per horse power for 500 horse power, or $20 for 700 horse power.

The town council of St. Stephen, N. B., have entered into a contract with the St. Stephen Electric Light Company to light the streets of the town for the next five years. The price is $60 per lamp per year.

The town council of Oakville, Ont., have granted the Hamilton Electric Radial Railway Company the privilege of operating an electric railway on Rebecca and Randall streets in that town. The company agrees to light the streets along which the cars run, carry small package freight, and supply the town with 500 horse power of electric energy.

Messrs. W. T. Clark, John McNeil, J. C. Wilbur, and R. H. Cuthburt, of St. John, N. B., and W. P. Bull, of Toronto, have been incorporated as the King Edward Oil Company, Limited, with a capital of $40,000 and head office in St. John. The company will manufacture and deal in oils, varnishes and paints.

A company of Toronto capitalists, headed by Mr. H. L. Dunn, has a proposition on foot to construct an electric railway from St. Catharines, Ont., to Niagara-on-the-Lake, thence along the river road to Queenston and back to St. Catharines, making a belt line 28 miles in length. The company ask for a loan of $25,000 from the city of St. Catharines.

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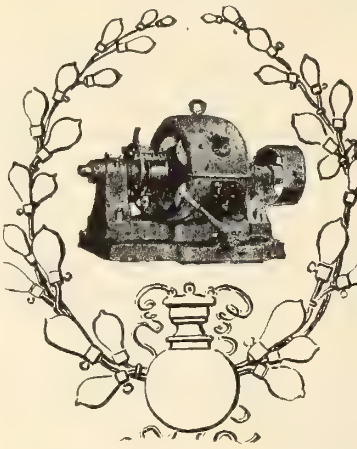
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SEND FOR TABLE OF CONTENTS

SPARKS.

The Winnipeg & Selkirk Street Railway Company are seeking power from the Manitoba Legislature to build a radial railway encircling Winnipeg.

Westinghouse, Church, Kerr & Company have just received an important export order from the Manilla Construction Company, an American corporation conducting operations in Manilla, P. I. The order comprises three 750 k.w. Westinghouse turbo-generator units, two compound engine exciter units, one motor-driven exciter, three 500 k.w. rotary converters, one 300 k.w. rotary converter, four 250 k.w. oil-insulated transformers, one series booster, switch-board and car equipments.

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2–12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.

The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address

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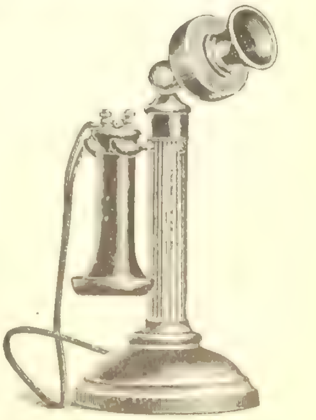


PUBLICATIONS.

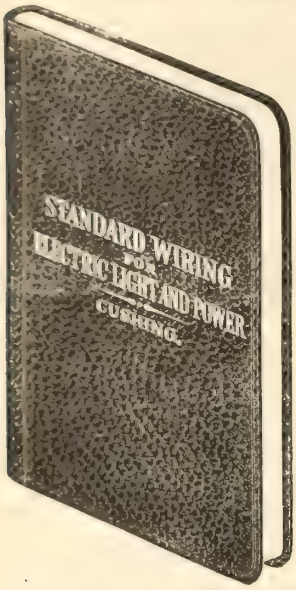
The Pittsburg Transformer Company, of Pittsburg, Pa., and the R. E. T. Pringle Company, of Montreal, have sent out neat souvenirs wishing their many customers a prosperous New Year.

Circular No. 1032 relating to the Westinghouse No. 56 railway motor, and No. 1059 relating to electric motor vehicle equipment, have recently been sent out to the trade by the Westinghouse Electric & Manufacturing Company.

A handsome souvenir bearing the Season's Greetings has been issued by the Canadian General Electric Company and the Canada Foundry Company. It contains excellent views of the works of the former company at Peterborough and Montreal and of the latter company in Toronto.

A bulletin designated No. 1, from the Rotary Engine Company, Philadelphia, Pa., introduces to the trade the Warren rotary engine, a type of prime mover which they claim is destined to mark a new era in the science of energy conversion. This engine is well adapted for direct connection with dynamos.

"American Meter Practise," by Lyman C. Reed: The subject of metering the output of central stations is of such importance as to guarantee a favorable reception for this book. The author has outlined the underlying principles of operation and practise and left the minor details to be worked out to suit local conditions. A number of well known and representative types of meters are described and there is an interesting chapter on "How to Read Meters." The publishers are the McGraw Publishing Company, 114 Liberty street, New York.



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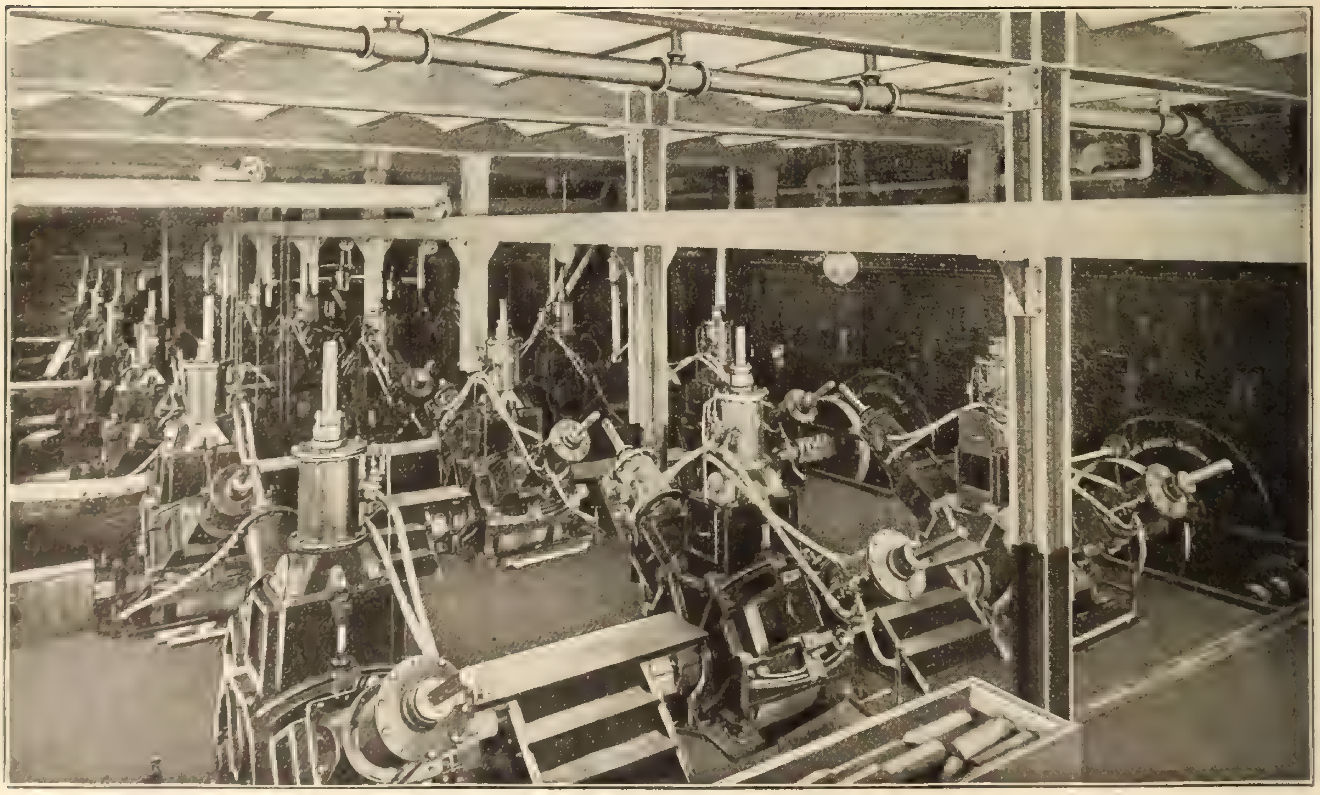

A Few of Our Grinders and Turbines at Brompton.

THE JENCKES MACHINE CO., LIMITED

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SHERBROOKE - QUEBEC.

TRADE NOTES.

The Toronto warehouse of the Canadian General Electric Company was closed for regular business on January 2, 3, and 4 for the purpose of taking their annual inventory.

The United Electric Company, of Toronto, have issued a neat folder describing a line of high grade telephones for offices and factories which they have lately placed on the market.

We have received from the Metallic Seamless Tube Company, Limited, Wiggin Street, Birmingham, a copy of their recent catalogue referring to their seamless cold drawn steel tubes, metallic steel conduits and fittings for electric wiring.

The Packard Electric Co, Limited, of St. Catharines, Ont., in a recent letter to their customers say: "As we look over our business for the past year, noting the tremendous increase which it has had, while admitting that the superiority of the goods has been a considerable factor in the increased sales, we can scarcely let the new year come upon us without addressing our friends and thanking them for the courtesy which they have shown us by the number of orders we have received. So we write you to thank you for any orders which you may have sent in, and to assure you that in the future the uniformly high standard which we have attained on Packard lamps, Type "G" meters and Type "R" transformers will be maintained. Our lamp department has recently been increased in capacity so that orders may be shipped quickly."

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Dynamo wanted — Second-hand Alternator; 60 K. W., in good condition. Box 400, ELECTRICAL NEWS, Toronto

Electrician, 22, seeks situation, under large company preferred; five years' experience erecting and running of small light and power plants; repairs, electrical and mechanical. English and French. Apply J. STEER, Minnedosa, Manitoba.

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SPARKS.

It is stated that the Brome Lake Electric Company, of Brome Lake, Que., is considering the advisability of installing a steam plant at Foster. The villages of Waterloo and Milton are supplied with current provided by this company.

The Winnipeg Electric Street Railway Company, as a mark of their appreiation of faithful service, gave as a Christmas gift to all employees who had been six months or more in their employ a bonus consisting of 5 per cent. To all monies received by each employee during the year ending November 30th, 1903.

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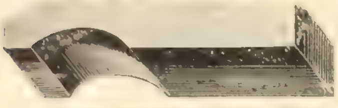

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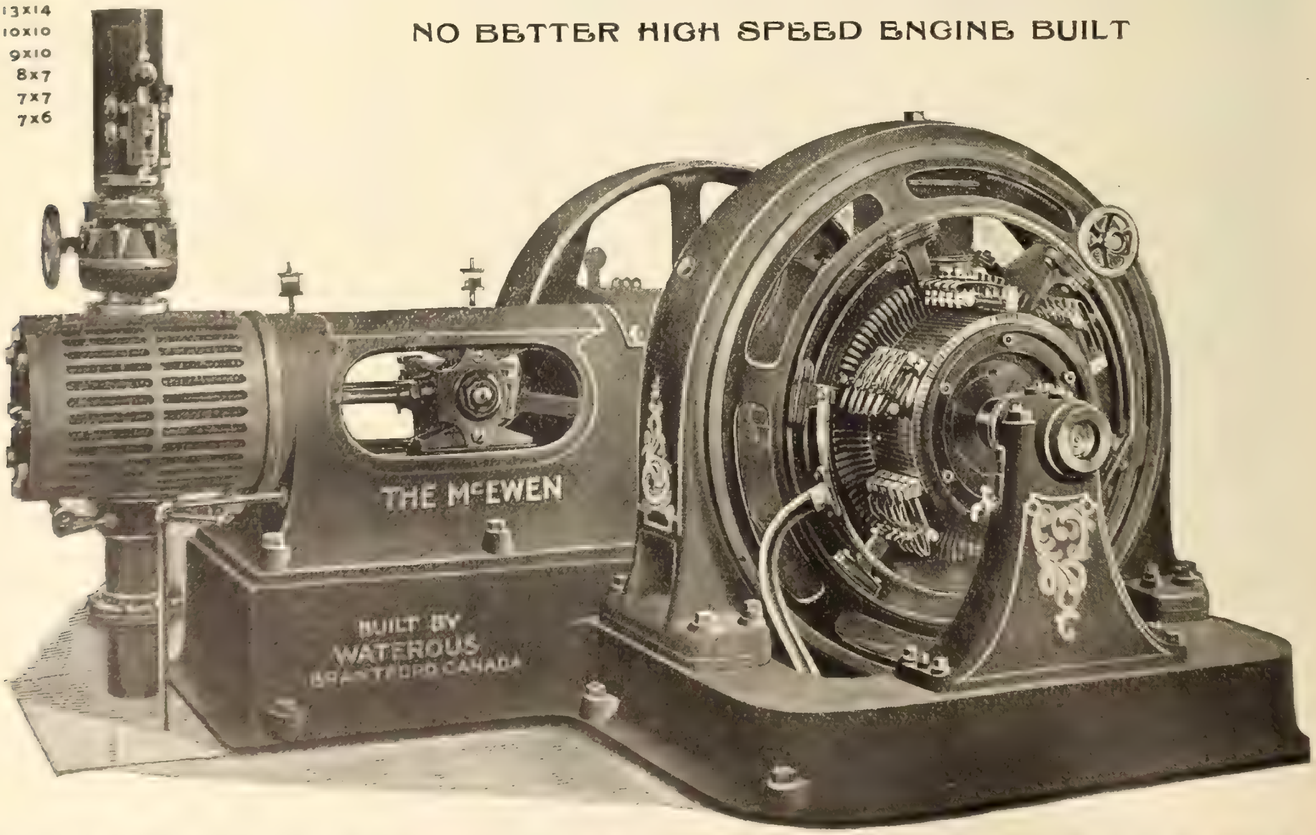

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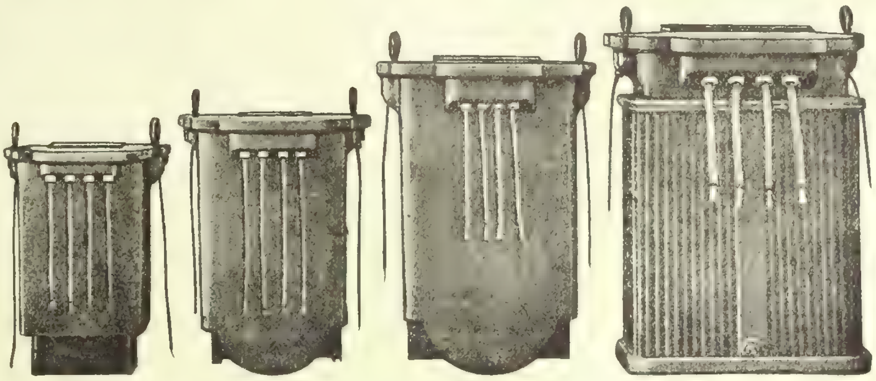
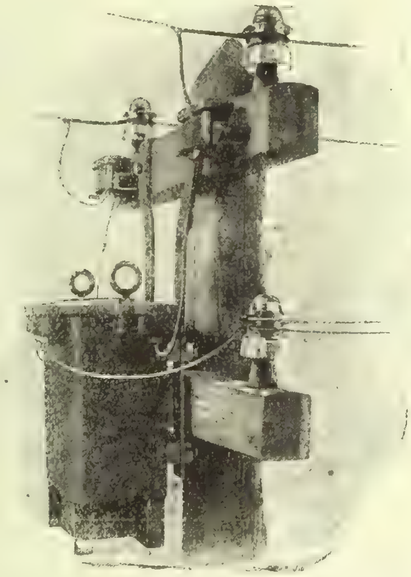


Type N and O D Transformers



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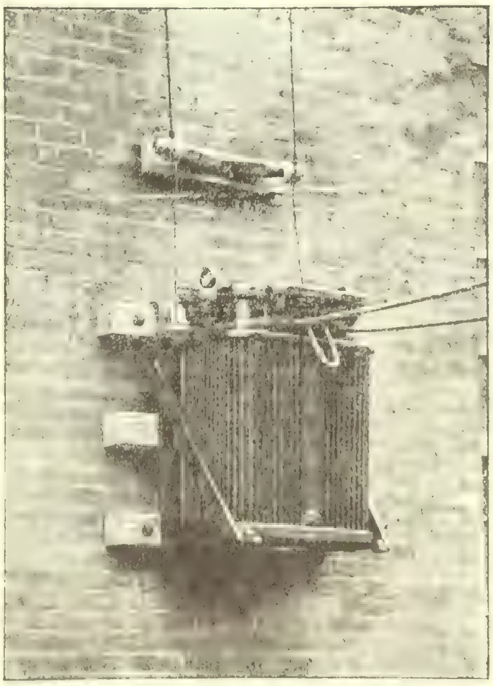

15 K.W. Transformer as Attached to Wall

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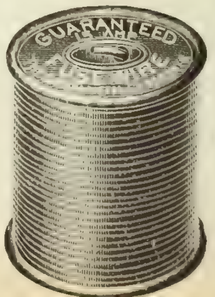

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No. 2.

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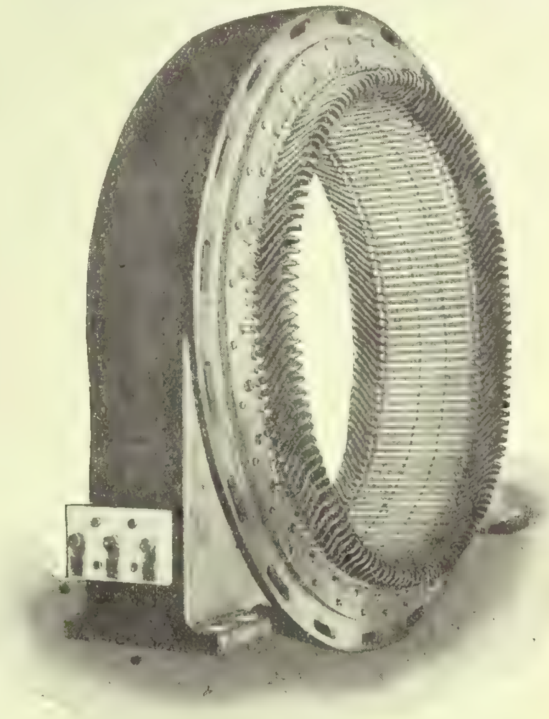

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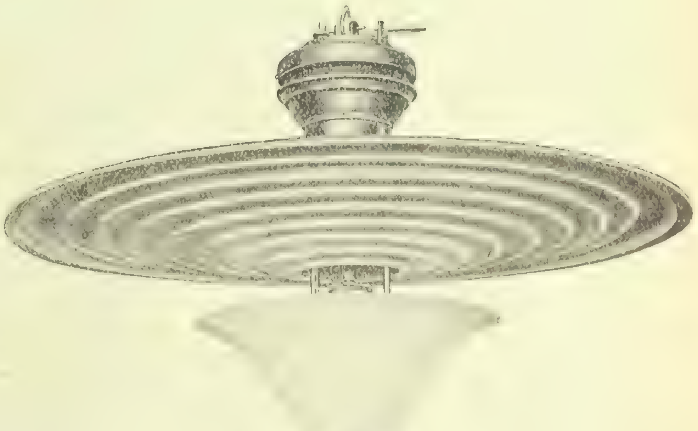

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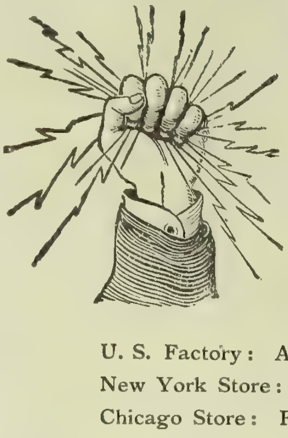

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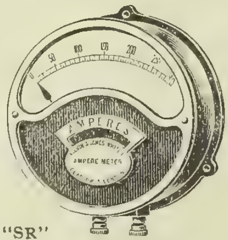

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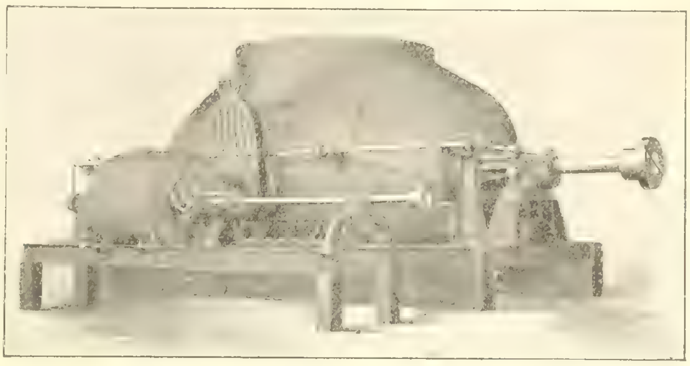

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THE LONDON STREET RAILWAY.

The statement presented at the annual meeting of the London, Ont., Street Railway Company, held last month, was of a gratifying nature. The gross earnings of the company for the year amounted to $172,084.53, as compared with $154,703.97 for the previous year, showing an increase of $17,380.56 or 11.2 per cent. Operating expenses were $109,493.15 as compared with $93,248.40. The net earnings after paying all charges were 7.91 per cent. on the capital stock. Two half yearly dividends of 3 per cent., amounting to $27,000, were paid, and after deducting directors' and auditors' fees, there remained a balance $6,124.10 to the credit of profit and loss account. During the year an extraordinary expenditure, not provided for when the estimates for the year were made out, had to be met. This was the increase in the pay of the conductors and motormen to 16 2-3 cents per hour, or an increase equal to 1 per cent. of the capital stock. The cost of coal was also increased 25 per cent. and the track and pavement repairs were greatly increased.

The number of passengers carried during the year was 4,305,975, being an increase of 418,277. The cars were operated for a distance of 1,286,263 car miles. Mr. H. A. Everett was re-elected president of the company, Mr. T. H. Smallman vice-president, and M. C. E. A. Carr general manager and secretary-treasurer.

PUBLICATIONS.

The Hinton Electric Company, Limited, Vancouver, B. C., have favored their friends with a pretty calendar.

The Consolidated Electric Company, of Toronto, have favored us with a calendar embodying a splendid portrait of His Majesty the King. This company manufacture the "King Edward" dynamo and motor.

Prof. C. A. Chant, of Toronto University, has issued a pamphlet on "The Variation of Potential Along Transmitting Antenna in Wireless Telegraphy." It is reprinted from the American Journal of Science and treats the subject in a very able manner.

We are again indebted to the National Carbon Company, of Cleveland, Ohio, for a useful calendar on which is shown a bird's eye view of the home of "Columbia" carbon products. The company claim that Columbia carbons are used exclusively in 90 per cent. of the enclosed arc lamps now burning in the United States.

Messrs. Frederick J. Drake & Company, 213 East Madison Street, Chicago, have issued a very useful book entitled "Modern Wiring Diagrams and Descriptions for Electrical Workers," the price of which is $1.50. The author has attempted to supply working electricians and students of electrical matters with such information as will assist them to take up any line of electrical construction work, and has succeeded in an admirable manner. The work is well illustrated.

The prospectus of the Eugenia Falls Water Power & Electric Company contains some excellent views of the falls at Eugenia, Ont., which it is proposed to develop. The directors of this company include Messrs. George F. Madden, manager of contract department of the Canadian General Electric Company, and Mr. B. F. Reesor, managing director of the Lindsay [illegible] t, Heat & Power Company. The secretary-tr

Thomas McLachlin, of Toronto.

The Convertible Car Company, of Toronto, has recently been organized, the provincial directors being Messrs. R. G. Dickson, C. A. Johnson, P. H. Drayton, H. M. Johnson and R. M. Fahey. The capital stock is $75,000.

The Bowmanville Electric Light Company, Bowmanville, Ont., intend enlarging their plant in the spring. They propose building a new dam about 500 feet below the old one, increasing their reserve water easily one half, and, according to the civil engineer's report, they will be enabled to obtain a 50 foot head by the change.

A charter has been granted to The Ontario Electric Light, Heat & Power Company, Limited, with a capital of $40,000 and head office in Toronto. Power is given to supply light, heat and power and to acquire the undertaking of the Colborne Electric Light & Power Company. The incorporators include Messrs. A. J. Walker, accountant, and R. W. Eyre, barrister, of Toronto.

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The Dodge Manufacturing Co. of Toronto, Limited, beg to announce to their many friends and customers in Eastern Canada that they have opened up a

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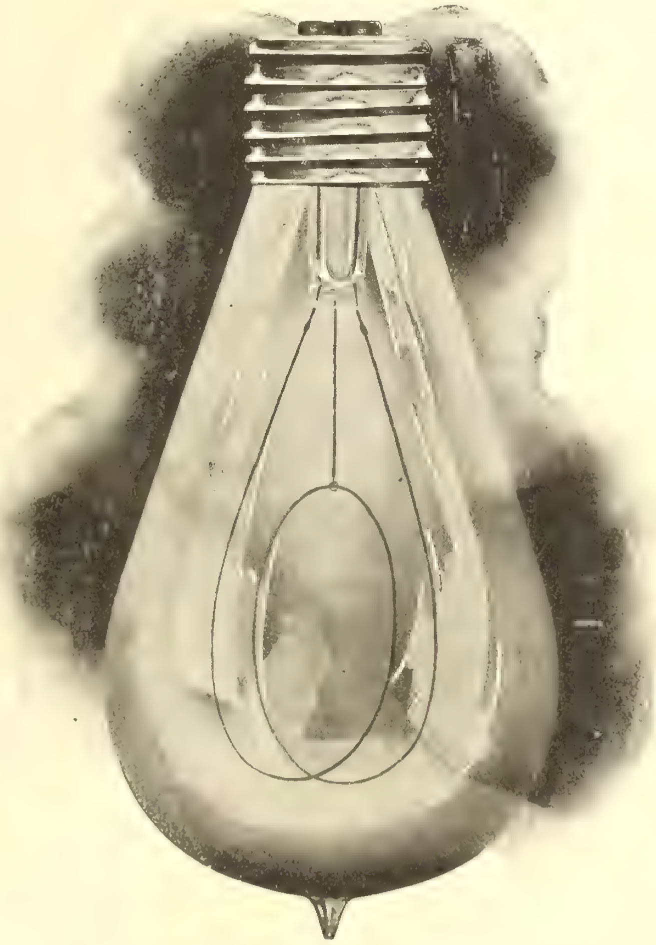

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SPARKS.

The Jones & Moore Electric Company, Limited, of Toronto has been incorporated.

Mr. L. H. Reesor, superintendent of the St. Mary's electric plant, has recommended the installation of a large single phase generator.

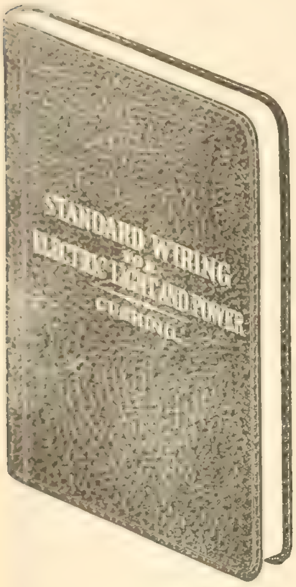
The Hull Electric Company is asking for tenders for the purchase and removal of material forming the building and flume of their temporary power house at Hull.

The Ottawa Street Railway Company have recently purchased what is said to be the largest snow plough in Canada. It will cover a sweep of eleven feet and is equipped with two 100 horse power motors.

The city of Calgary, N.W.T., has just taken tenders on the construction of a power house for the waterworks and electric light plants. The consulting engineer for the work is John Galt, C.E. & M.E., of Toronto.

Richard O'Leary, Frederick O'Leary, William Hogan and Henry James, of Richibucto, N.B., and W. J. O'Leary, of Montreal, have been incorporated as the Kent Electricial Company, Limited, with a capital stock of $20,000 and headquarters at Richibucto, N.B.

The Electrical Development Company, of Ontario, Limited, of which Mr. Frederic Nicholls is general manager, is asking for tenders for the supply of 20,000 barrels of Portland cement, required for the construction of power house and other works at Niagara Falls.



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NOVA SCOTIA ENGINES IN AUSTRALIA.

Mr. D. H. Ross, Commercial Agent for Victoria, South and West Australia and Tasmania, writes to his father as follows: "At the power house of the Perth Electric Tram Company, I was pleased to observe two 300 horse power engines, manufactured by the Robb Engineering Company of Amherst, Nova Scotia. These engines (Nos. 472 and 473), have been working almost continuously 18½ hours daily, for over three years. The engineer in charge intimated the excellence of their work.

"The general manager and engineer of the Perth Electric Street Railway is Mr. H. J. Somerset, formerly of Winnipeg, to whom I am indebted for many courtesies. Mr. Somerset is also engineer of the Kalgoorlie Tram Company, and the chief authority on electric traction in Western Australia."

TENDERS FOR ELECTRIC TRAMWAYS.

The construction of an electric railway is about to be undertaken at Christchurch, New Zealand, for which tenders will be received by Mr. William Reece, Chairman Christchurch Tramway Board, 201 Gloucester street, Christchurch, up to March 17th, 1904. Tenders are asked for the following sections:—(a) Power house equipment, steam plant; (b) power house equipment, electrical plant; (c) steel stack; (d) travelling crane; (e) cooling tower; (f) car bodies; (g) car trucks; (h) car motors; (i) compressed air brakes; (j) equipment of cars and sundry supplies; (k) repair shop tools; (l) rails, fishplates, fishbolts and special work; (2l) permanent way; (m) overhead construction; (n) emergency waggon; (o) destination boxes, tablet and staff boxes; (p) life guards.

SPARKS.

The exports of electrical machinery from the United States to British North America in 1903 were valued at $1,380,198.

The ratepayers of the towns of Port Arthur and Fort William, Ont., recently carried a by-law favoring the operation of street cars on Sunday.

Messrs. Theo. Audel & Co., of New York, will be pleased to send free their catalogue of electrical and engineering books to any of our readers who will write them mentioning their advertisement in the ELECTRICAL NEWS.

The Town Council of Port Arthur, Ont., have appointed a committee, consisting of the Mayor and Councillors Cooke and Ray, to take steps looking to the development of power on the Current River. An expenditure of $100,000 for the purpose is talked of.

Prof. McKinnon recently lectured to a large audience at Toronto University on "Radium and Radio-activity." In a most interesting address, illustrated with a variety of experiments, he traced the discoveries that have been made up to the present time in connection with the remarkable phenomena of radio-activity.

An electric sign containing ten incandescent lamps can be used in New York city two hours daily at a monthly cost of only $2.25, according to the New York Edison Company's Bulletin. Four hours per day cost $3.75 a month. A twenty-lamp sign five hours daily costs $8.65 monthly, and the cost of a fifty-lamp sign for the same period is $21.50. The ten-lamp sign costs seven and a half cents per day, and need be seen by only eight persons to reduce its cost to the price of a postal card without printing. But there are locations in New York where such an advertisement may be seen by from 250,000 to 500,000 persons daily, for it is as active in daylight as after dusk.—Printer's Ink.

It is said that down in Madoc, a charming village in Hastings county, they have decided to paint the sidewalks white in order to avoid the use of electricity. The news comes from the editor of a sparkling weekly, printed in a neighboring town, and it may be that Madoc is falsely maligned; but if true, it seems to be a strange notion, particularly as Madoc is not in poor circumstances. "All around," it is declared by an ardent admirer, "are corundum enough to rasp the asperities of every politician, marble enough to build a city, gold enough to pay the national debt and graphite enough to lubricate every wheel in Canada." The only thing we doubt about it is the lubricating quality of the graphite. If the imaginative scribe had only said graphite enough to provide pencils sufficient to write all the slanders that were ever conceived, we should have believed him absolutely.—Ottawa Free Press.

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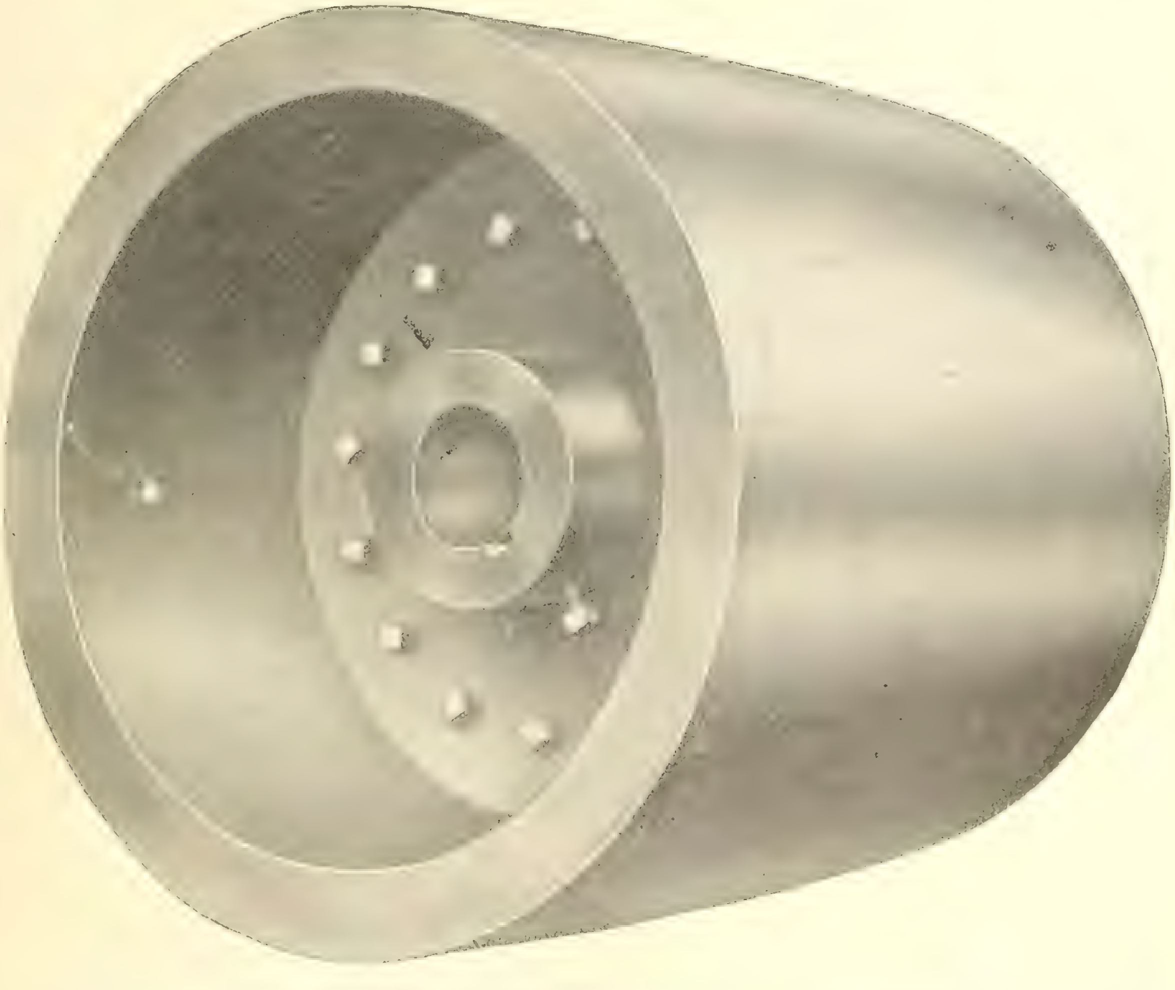

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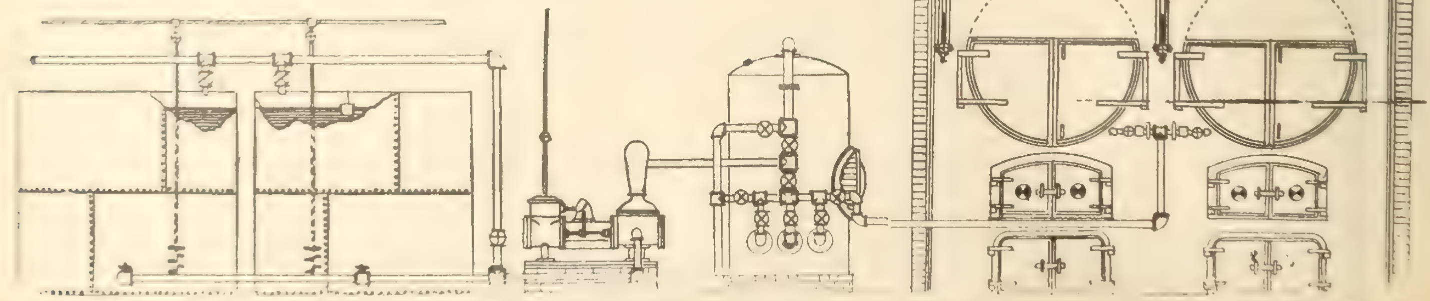

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AND
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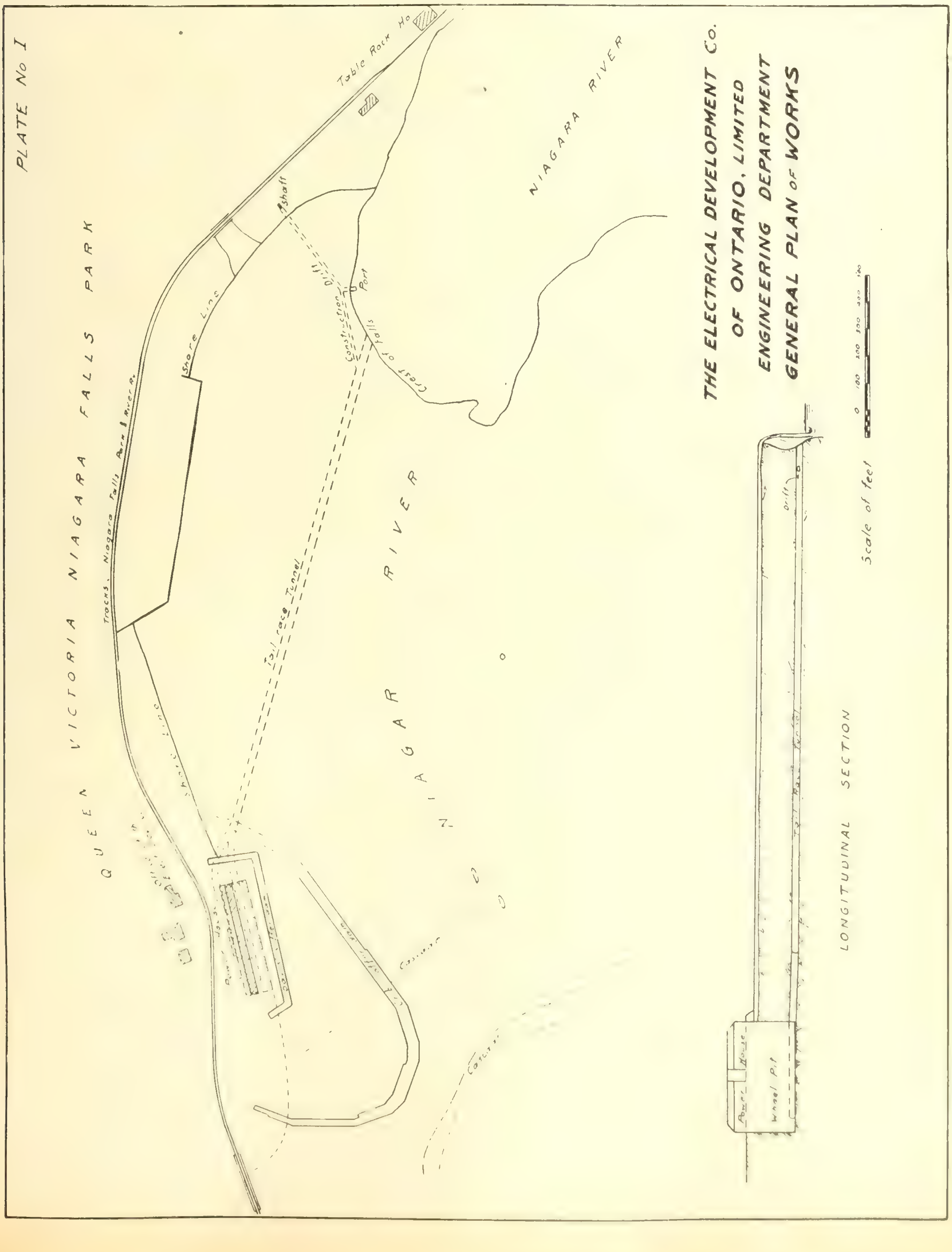


[For Description See Following Pages.]

ELECTRIC POWER DEVELOPMENT AT NIAGARA FALLS.

By the courtesy of the Electrical Development Company of Ontario, Limited, and the Toronto and Niagara Power Company, we are enabled to present in this number several reproductions of plans and photographs of the immense power development works now under construction by these companies at Niagara Falls, as well as a brief review of the progress of the work as abstracted from the official statements of the engineers.

The Electrical Development Company of Ontario, was incorporated by the Legislature of Ontario February 18th, 1903, with a capital stock of $6,000,000. Messrs. William Mackenzie, H.M. Pellatt and Frederic Nicholls had previously been granted rights to take water from the Niagara River at Tempest Point for the purpose of generating electricity to the extent of 125,000 electrical horse power, which rights were acquired by the company. The officers are: President, H. M. Pellatt; vice-president and general manager, Frederic Nicholls; second vice-president, William Mackenzie; secretary, H. G. Nicholls; treasurer, D. H. MacDougall. Mr. F. S. Pearson, Dr. Sc., was appointed chief consulting engineer, Mr. Hugh L. Cooper chief hydraulic engin-

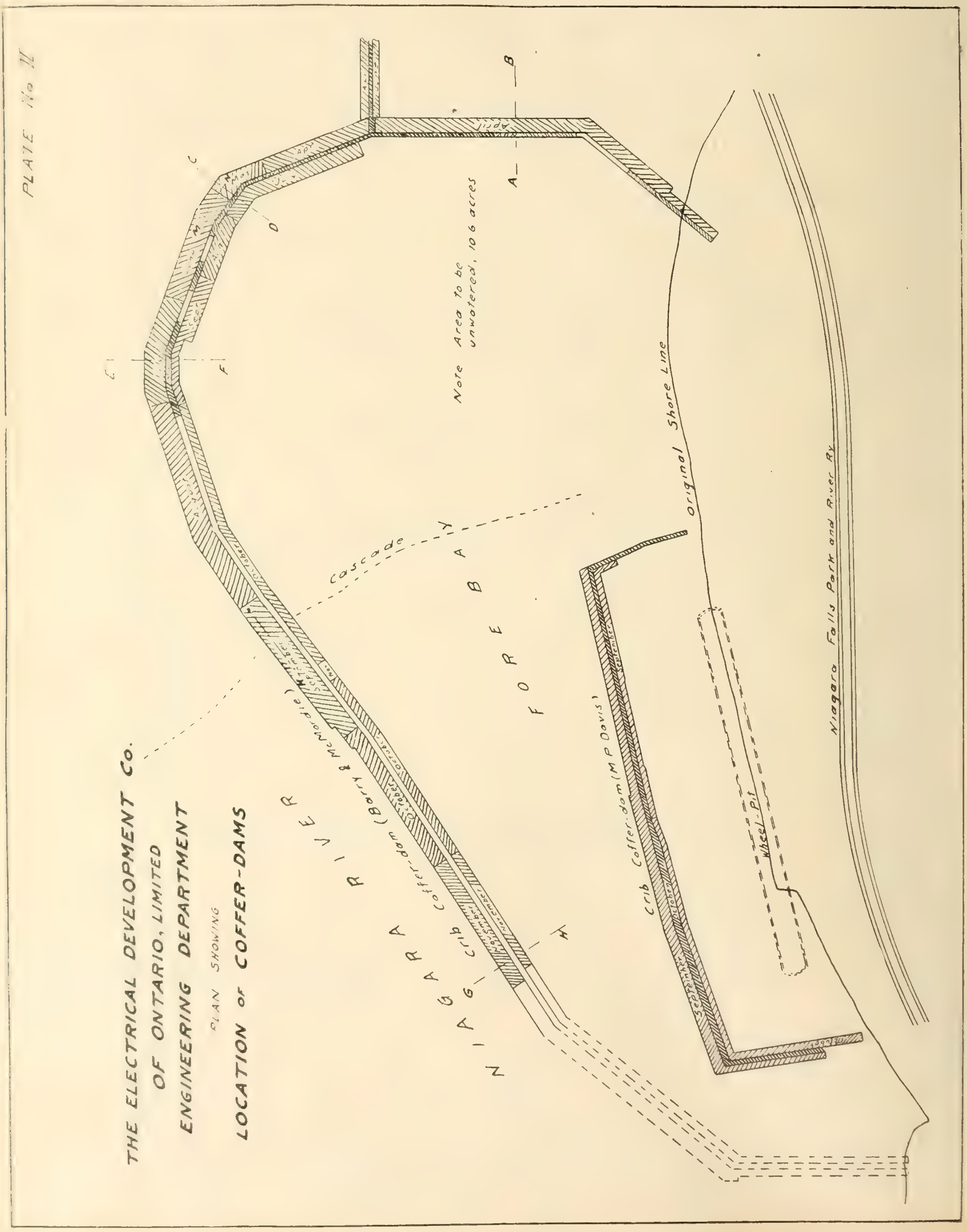


PLATE No. II
THE ELECTRICAL DEVELOPMENT Co.
OF ONTARIO, LIMITED
ENGINEERING DEPARTMENT
PLAN SHOWING
LOCATION OF COFFER-DAMS
Note Area to be unwatered, 106 acres
Original Shore Line
Niagara Falls Park and River Ry
Cascade
FORE BAY
NIAGARA RIVER
Crib Coffer-dam (Barry & McMordie)
Crib Coffer-dam (M P Davis)
Wheel-Pit
A
B
C
D
E
F
H

eer, and Mr. Beverley R. Value, resident engineer for the proposed works at Niagara Falls.

The Toronto & Niagara Power Company held the charter rights to expropriate lands and accordingly undertook to secure a private right of way between Toronto and Niagara Falls on which to construct the pole line for the transmission of energy. Mr. W. T. Jennings, M.I.C.E., was appointed engineer-in-chief of this work.

The report of Mr. Pearson, the consulting engineer, states that when the work was commenced it was recognized that the greatest difficulties the company would have to encounter would be in the installation of the coffer dam and the commencement of the work on the main tail race tunnels. It was considered by many that it would be impossible to carry out the work as outlined on the original plans. Both of these problems, however, were solved in a very satisfactory manner and without serious expense or delay. It was assumed in the original estimates that the depth of the water would be about 8 feet as a maximum on the line of the coffer dam, and in view of the fact that this dam was to be located in the midst of the rapids of the Niagara River it was expected that it would be a difficult operation to

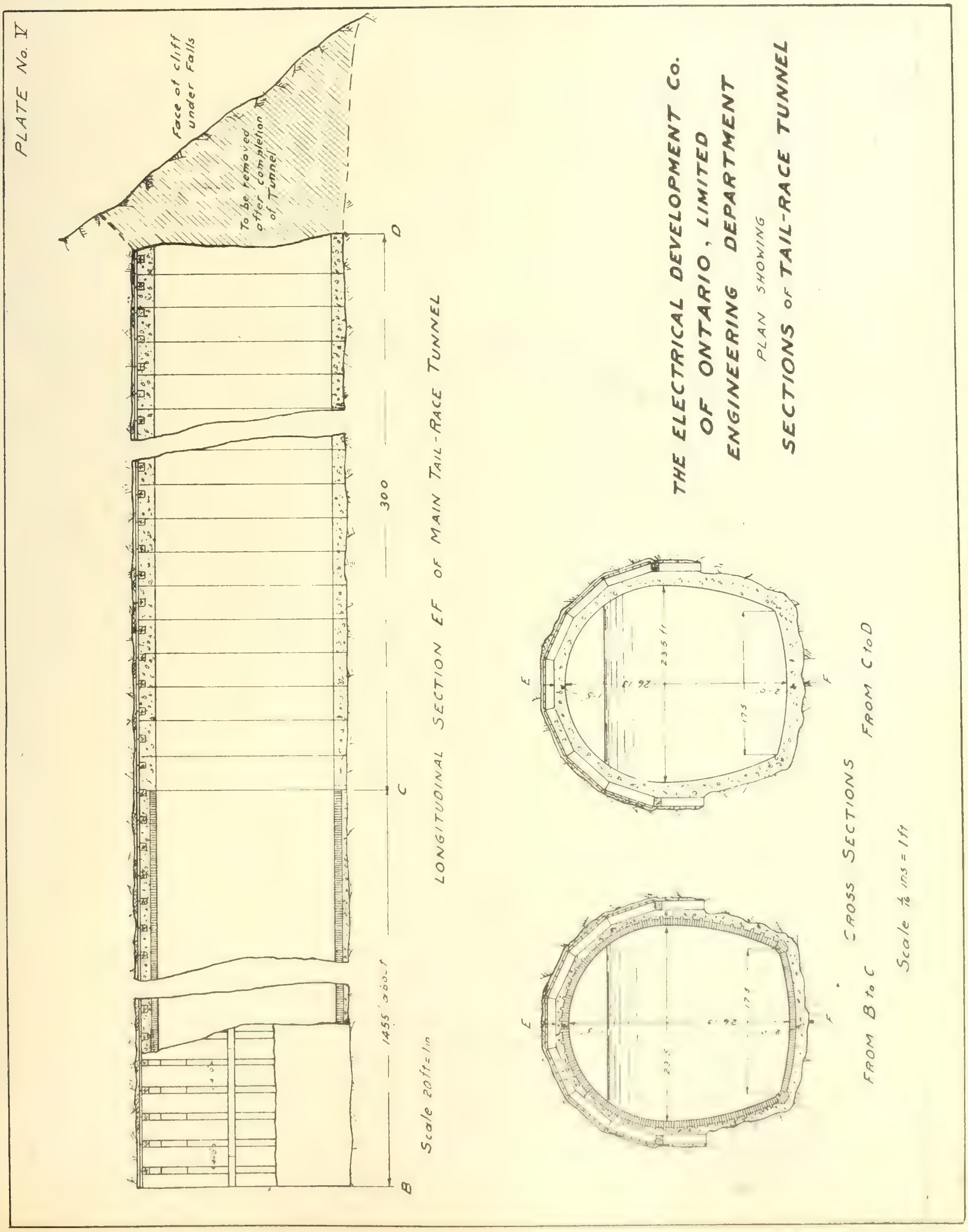
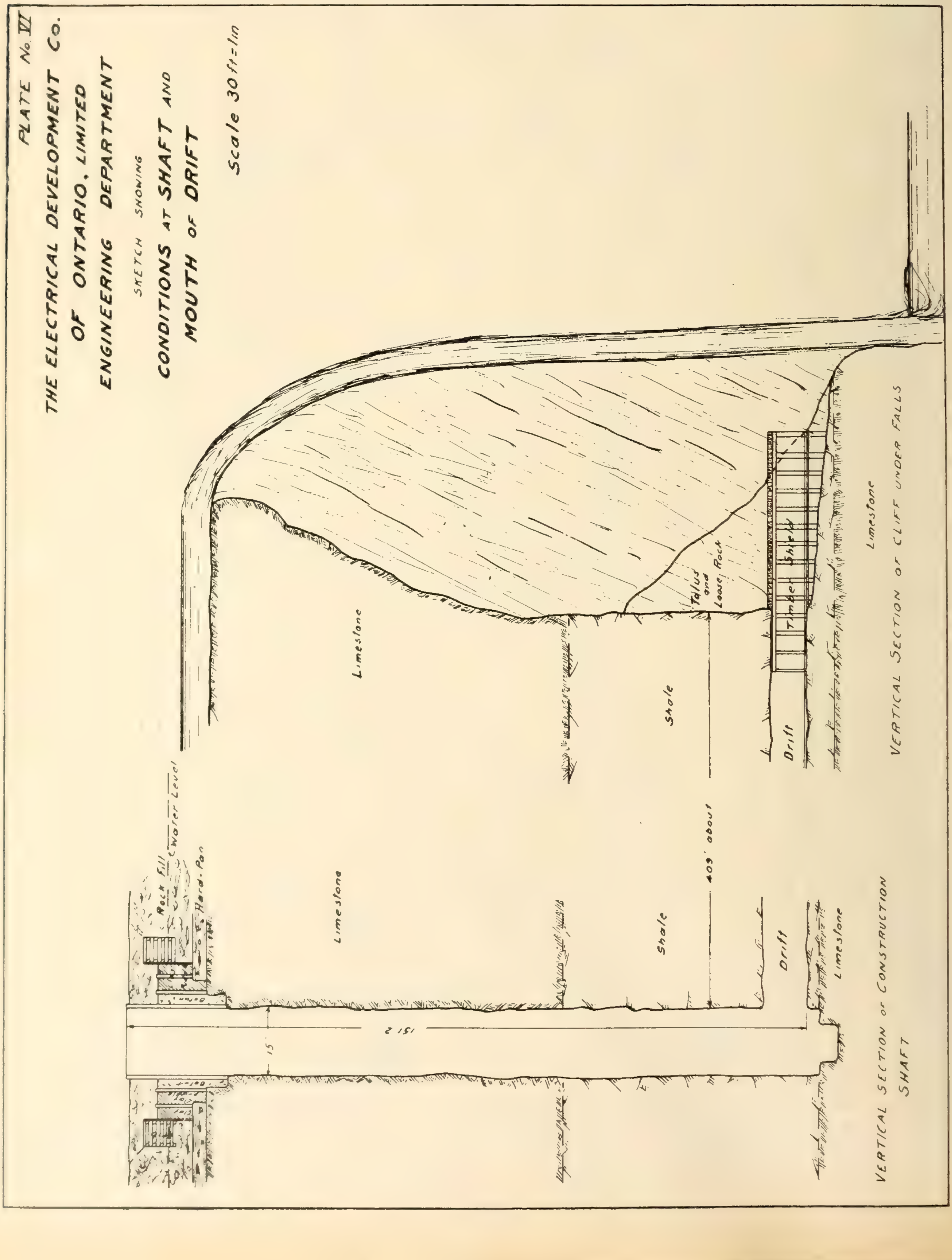


PLATE No. V
Face of cliff under Falls
To be removed after completion of Tunnel
D
300
C
1455' about
B
Scale 20ft = 1in
LONGITUDINAL SECTION EF OF MAIN TAIL-RACE TUNNEL
THE ELECTRICAL DEVELOPMENT Co.
OF ONTARIO, LIMITED
ENGINEERING DEPARTMENT
PLAN SHOWING
SECTIONS OF TAIL-RACE TUNNEL
E
F
23.5 ft
26.1
17.5
CROSS SECTIONS FROM C to D
FROM B to C
Scale ¼ ins = 1 ft

build a structure that would withstand the excessively rapid current. As the work on the coffer dam proceeded it was found that there were 26 feet of water, but even with this extraordinary depth good progress was made, and on December 12th last there remained only a short spur to connect with the shore in shallow and still water.

The plan for the tail race tunnel required a portal under the Falls. There have been various theories regarding the condition under the Falls, as there are, at times, noticeable explosions, apparently due to compressed air, and it was predicted by engineers that it would be impossible to open a tunnel portal at the point selected on the plan. In order to reach the line of the main tunnel a subsidiary tunnel of about 600 feet in length was required, and to ascertain conditions under the Falls, as well as to provide for dumping the debris of excavation, an opening was planned about the midway of this tunnel. Long before an opening was effected the subsidiary tunnel was flooded with water, which leaked through cracks at the face of the cliff. For several weeks the contractor had a great deal of trouble in overcoming this difficulty, but finally an opening was effected which completely drained the tunnel and



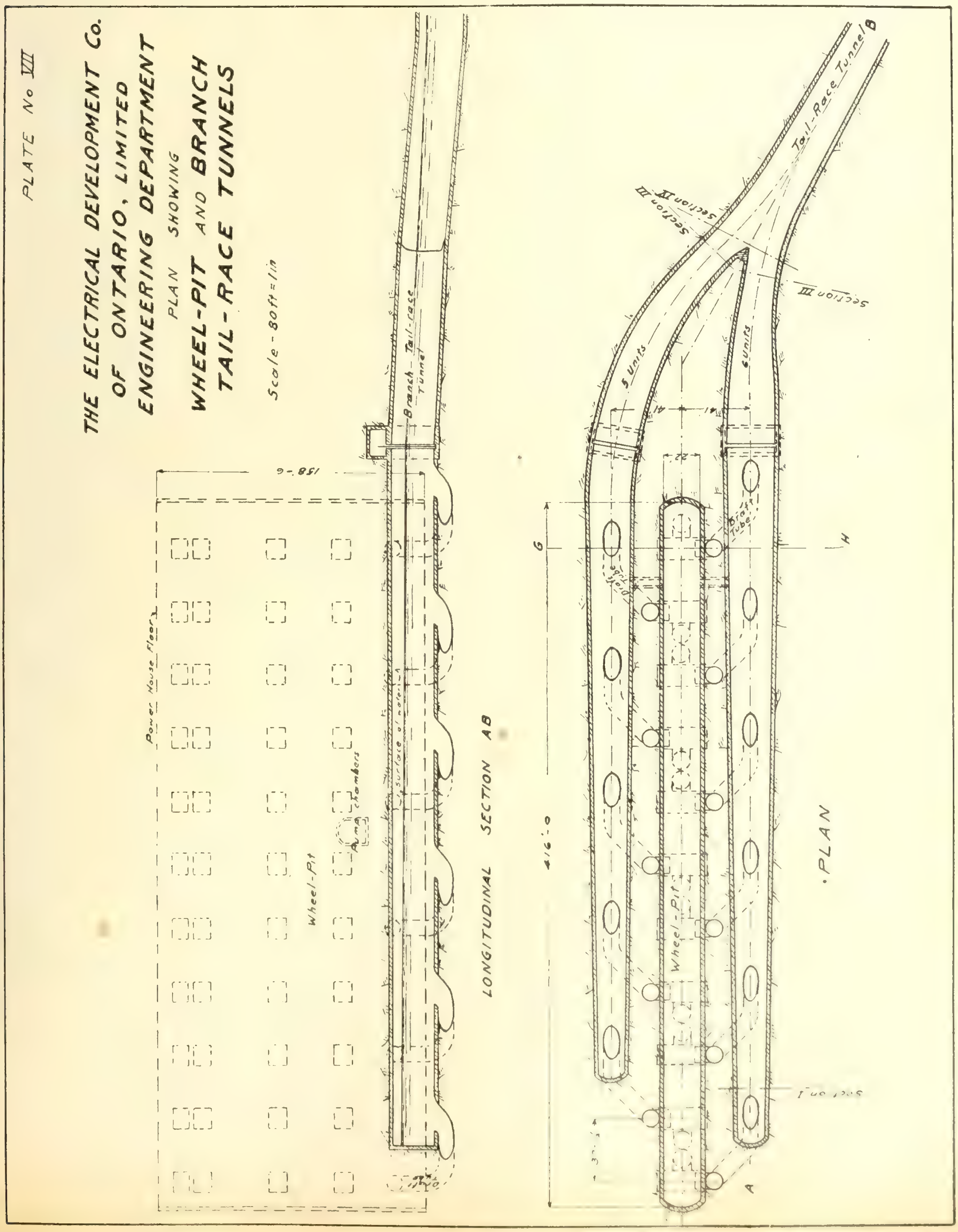
also proved that it was perfectly feasible to place the terminal of the main tail race tunnel at any point desired.

On account of the magnitude of the installation, and the immense volume of water required for its operation under maximum conditions of load, there was a question in the minds of engineers as to the volume of water readily available for the work, this question arising from the assumption that the maximum depth of water was only about 8 feet. Now that the coffer dam is installed, and the great depth of water of 26 feet has been found, all questions regarding the supply of water have been set at rest, as it is evident that the amount of water available is several times in excess of that required.

REPORT OF CHIEF HYDRAULIC ENGINEER.

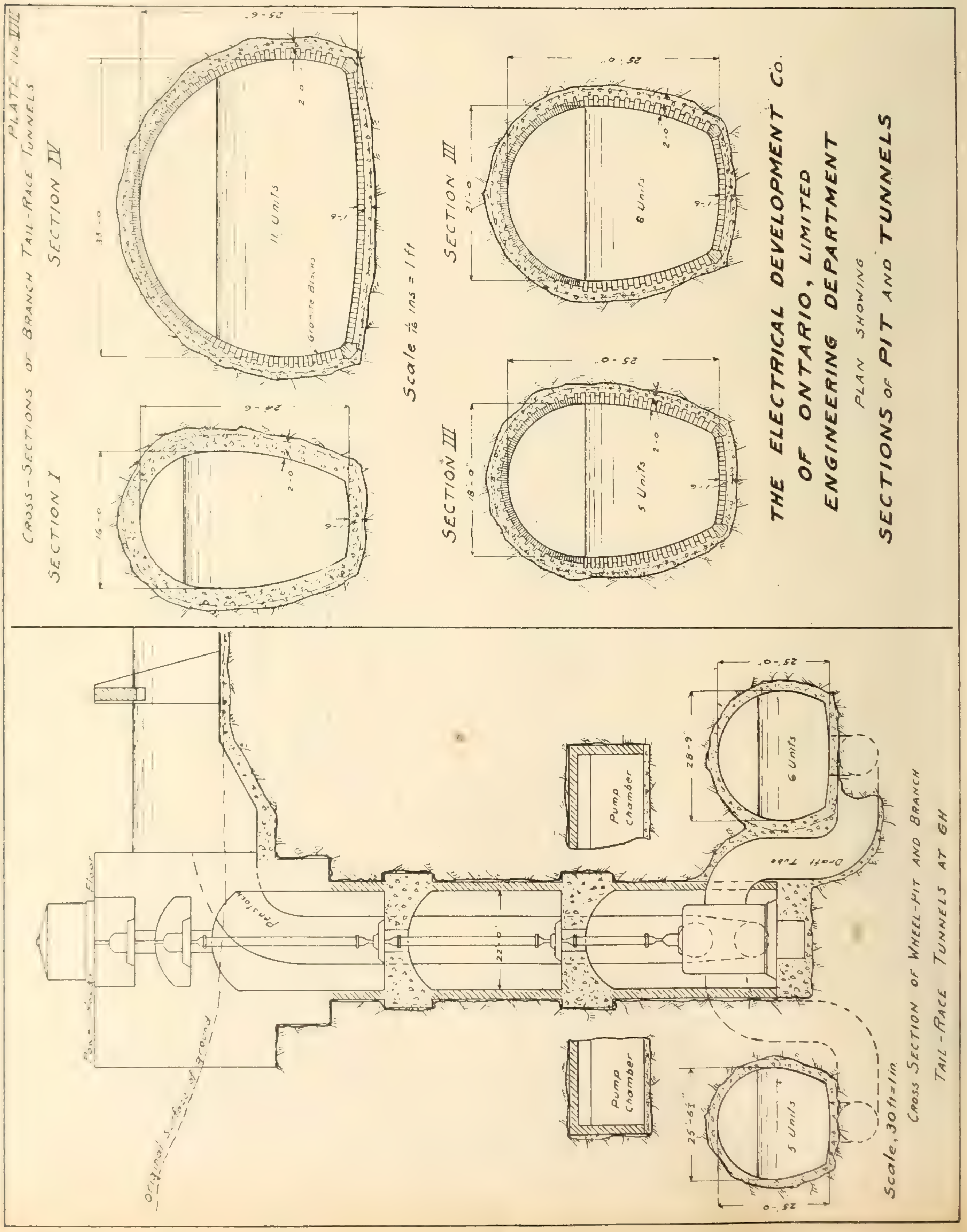
Mr. Hugh L. Cooper, chief hydraulic engineer, in a brief general description of the plans, makes the following statements:

"In order to appropriate to the permanent use of plant a reliable quantity of water, the gathering dam shown on the plans has been designed, the purpose of which is to introduce upon the bed of the Niagara River a gathering dam, opening up the stream, and at



the mouth of which dam there shall always be an area that will naturally receive a sufficient amount of water for the necessities of the plant, and at the same time divert these waters to the conduits leading to the wheel pit. In the location of this gathering dam, due consideration has been given to the natural currents of the river and to the small changes that may result in the same due to the construction of the works of the Ontario Power Company situated above our site. The gathering dam above referred to will be built of masonry, properly founded and so designed that the possibility of future attention to this structure should be dismissed.

"This gathering dam changes the original rapids in front of the site into a ponded condition and raises the old water level approximately 18 feet under normal conditions. Connecting to this gathering dam and a part thereof, will be constructed a system of masonry diverting booms with submerged orifices, the office of all of which will be to divert approaching ice and debris to suction weirs and overflow capacities provided for in the crest of the gathering dam. The manipulation of ice and debris is best accomplished where the structures involved offer the least obstruction to the ice, and in the designs adopted the gathering dam and



diverting booms will be so nearly parallel to the direction of the flow of the Niagara River as to reduce annoyance of this kind to a minimum. The point of land above our intake is so situated as to in itself act as a huge natural fender in the diversion of ice from our headworks.

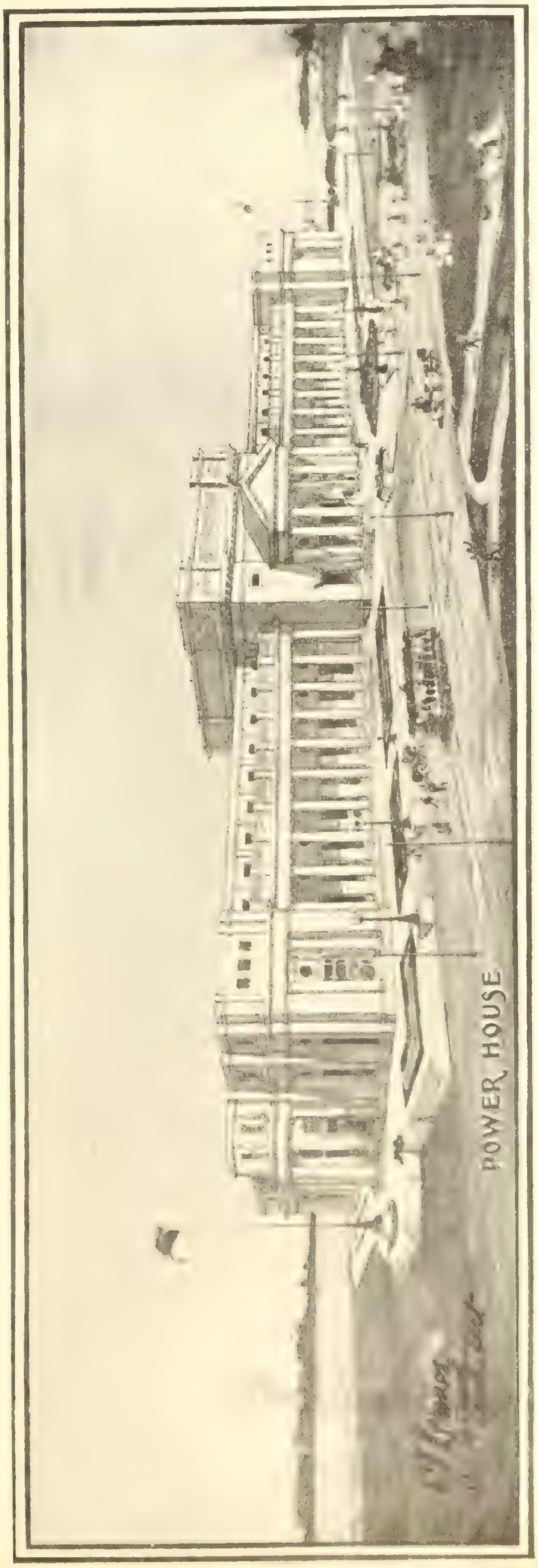
"The water thus gathered will be conveyed downward through steel tubes to the water wheels located in the bottom of the wheel pit, and the differences of level provided by the design are such that, after deducting losses from friction and the velocity of approach and discharge, there will remain an operating head of 143 feet to be used by the turbines. In order to obtain this operating head the design calls for the construction of the wheel pit through solid rock, as shown on plans. This wheel pit is provided with masonry lining as shown, and the provision that the turbines and all of the machinery above them shall rest upon solid rock foundations, instead of artificial supports as has hitherto been the practice, is an element newly adopted for this construction, and the value of this provision is self-evident.

"The eleven generators provided for in the complete plans will be installed on masonry foundations at the level of the power house floor, and the connection between the generators and the turbines at the bottom of the wheel pit will be made by the use of a hollow shaft, travelling in a vertical position, and having a total length of approximately 115 feet, supported at three intermediate points by solid masonry bearings, as shown on the drawings.

"The two elements in the wheel pit of placing the labor of supporting all of this machinery upon solid rock foundations, and the provision of masonry intermediate supports for the shafting, are a departure from previous practice, but have been adopted in order that the serious element of vibration in heavy revolving machinery may be reduced to an absolute minimum, and the expense of upkeep thereby have its proportionate reduction.

"The water, after the performance of its labor in the turbines, will be discharged through steel draft tubes to two branch tail-race tunnels connecting with the upper end of the main tail-race tunnel. This design is also a departure from previous practice, but has been adopted for two important reasons: In the first place, it is not to be assumed that machinery can ever be so installed as to remove the necessity of future repair. By the use of the two branch tail-race tunnels, as designed, it will be possible at any time to close down one-half of the station and make any necessary repairs without the other half of the station being interfered with. In other words, the use of the two tail-race tunnels designed, in practice makes two stations of the one station, each half being absolutely independent of the other. This provision also is important because in active operation, if the design permits, it is always desirable to make frequent examinations of the machinery in order that the beginnings of trouble may be discovered before serious expense has accumulated. This design will permit of weekly examinations of each half of the station at nights when the peak loads are off and at any time when the loads are such that one half of the station can carry them. Another important value in this design of discharge is that the turbine themselves will always be accessible and not be submerged at times as in other plants, and as such their care can have intelligent supervision.

"The water, after it is delivered to the branch tail-race tunnels, is by them conducted to the main tail-race tunnel which here originates, and the same from here continues in a straight line and with a grade of 5½ feet in a thousand to a point of discharge behind the main sheet of the falls. This tunnel, in being straight, is free from special erosion to its lining due to a change in the direction of rapidly moving water.



Proposed Power House in Queen Victoria Niagara Falls Park for the Electrical Development Company of Ontario, Limited.

REPORT OF RESIDENT ENGINEER.

According to the report of the resident engineer, the contract for the crib coffer dam was awarded to Barry & McMordie, of Niagara Falls, Ont., on March 14th, 1903, and up to December 31st the amount of work accomplished under the contract was as follows: 2,258,568 feet B.M. of timber in place; 15,416 cubic yards of rock filling measured in place in the crib; 2,520 cubic yards effective puddle in place; 1,470 cwt. iron work in place. It was found that the extension of the crib into the river beyond the second angle was causing a backing up of the water, and to prevent a flooding of a portion of the fore bay a spur crib was constructed from this angle leading up stream along the edge of the heavy flow. The contract for the building of this extension was given to Barry & McMordie on June 17th, 1903, and by December 31st the following work had been done: 117,700 feet B.M. timber in place; 707 cubic yards rock filling measured in place in the crib; 211 cubic yards effective puddle in place; 45 cwt. iron work in place.

To December 31st 1,794 feet of main coffer dam had been placed, which was reinforced for a distance of 1,296 feet with additional crib work varying in thickness from 16 to 8 feet. To complete the work to an intersection with the shore below the wheel pit would require 343 feet of additional crib work.

The contract for the tail race tunnel was awarded to Anthony C. Douglass, of Niagara Falls, N. Y., on May 14th, 1903. As the tail race tunnel lies under the river bed for its entire length, provision was made in the contract for a construction shaft to be sunk on the west shore of the river above the Falls, and a small working tunnel or drift to be driven under the river out to the tail race tunnel, the excavated material to be disposed of either by hoisting vertically through the shaft and wasting over the bluff, or by dumping under the Falls through openings from the drift to the cliff back of the curtain of water. The drift is 670.9 feet in length, measured from the shaft. The length of the tail race tunnel, from the cliff under the Falls to the branch tunnels at the wheel pit, will be 1,935 feet. For a distance of 300 feet from the face of the cliff the tunnel will have a permanent lining of concrete, divided by vertical joints into rings 6 feet in length, in order that, as the Falls recede these rings will break away as a whole, leaving a finished surface at the new end of the tunnel. For the balance of the distance the tunnel will have a permanent lining of two rings of hydraulic pressed brick backed solid to the rock with concrete. A light steel gallery, for inspection purposes, will be suspended from the roof of the tunnel and lighted by electricity. The dimensions of the drift are, approximately, 14 feet in width by 7 feet high, an area sufficient for two construction tracks.

The following work was accomplished under this contract to December 31st: 158 linear feet of construction shaft excavation; 741.4 linear feet of construction drift excavation; 11 linear feet of tail race tunnel excavation.

The contract for the wheel pit and tail race branch tunnels was awarded to M. P. Davis, of Ottawa, on July 21st, 1903; work was begun on August 10th. The wheel pit is designed for an installation of 11 turbine wheels each of 12,500 h. p. capacity. The tail race tunnel branches at a point 165 feet from the lower end of the wheel pit into two lateral tunnels, which pass on either side of the wheel pit. The intervening rock is pierced at intervals by draft tubes, which enter the lateral tunnels through the invert. A water seal is thus preserved at all stages of operation. Single draft tubes are used, each alternate wheel discharging into the same tunnel, six draft tubes entering the north tunnel and five the south. Gate chambers are provided for each side tunnel, so that it is possible, by closing the gate in either tunnel and shutting down the wheels discharging into this branch, to make an inspection while the other half station is in operation. A chamber will be excavated at the level of the turbine deck for the oil pumps and other auxiliary machinery. As the site of the wheel pit had not been unwatered by the crib coffer dam at the time of the awarding of this contract, provision was made for the construction of an inner coffer dam, by the wheel pit contractor, surrounding his work, within a minimum clearance of 35 feet from the head gates.

It is stated that on account of the advantageous location of this plant, the cost per horse power will be exceptionally low. With a transmission line to Toronto of capacity sufficient to deliver 30,000 horse power, the total cost per delivered horse power at Toronto will be as low, if not lower, than that for any other plant of a similar nature that has been constructed. The generating units will be eleven in number, of 12,500 h. p. each, revolving at 250 revolutions per minute

Plans for the power house have been prepared by Mr. E. J. Lennox, architect, of Toronto. The building will be 500 feet long and 70 feet wide, with an elevation about 40 feet in height. The front elevation will have a centre and two end bays and the spaces between centre and end bays of the facades will be set back about 6 feet with large windows and forming a loggia. It is intended to be built of light granite.

The location of the route for the transmission line, to be built by the Toronto & Niagara Power Company, has been completed. The distance from the power house to Scarlet Road, Lambton, on the north-western confines of the city of Toronto, is 75½ miles. The location has been selected with a view to the utilization of the right of way lands not only for electric power transmission lines but for railway purposes, and it is stated that the country traversed does not present serious engineering difficulties. About 85 per cent. of the right of way, having a minimum width of 80 feet, had been purchased by December 31st last. The contract for fencing has just been awarded to Mr. Dickenson, of Hamilton.

The Empire Power Company, Limited, has been incorporated at Owen Sound, Ont., with a capital of $500,000. Power is granted to construct and operate works for the production of electricity. Those behind the scheme are Messrs. J. M. Kilbourn, F. H. Kilbourn, G. H. B. Bruce and G. S. Kilbourn, of Owen Sound, and E. A. Peck, of Peterborough.

The annual meeting of the shareholders of the Sherbrooke Light, Heat & Power Company, of Sherbrooke, Que., was held on January 21st. The reports submitted showed that the number of users of electric light had increased during the year and that the results of operating were satisfactory. A resolution was passed agreeing to accept the city's offer of $200,000 for their plant on condition that the city would also take over the gas works, as it would not be practicable for the company to maintain its organization for the sole purpose of continuing the operation of the gas plant.

QUESTIONS AND ANSWERS

1. Would you please say in your next issue how we can get about the actual h. p. output of a 500 v. A. C. 2 phase motor? Can we guide ourselves on the difference of amperes consumed when running light and when running with a load. At normal conditions for the above named motor when same is giving about ten h.p., how many amperes at 500 volts should we have on one leg to equal ten h. p. output, the voltage at motor being right?

Ans.—The only proper way, unless you know the exact power factor and efficiency of your motor for any given voltage and current input, is to make a brake test, but this requires certain special appliances and more or less time. The next best method is to obtain from the manufacturers of the machine a curve or table showing the horse power output for any given ampere input. The difference between the current light and load is no guide, as at no load that required for magnetization and to supply the other losses in the motor may be 20 to 30 per cent. that of the full load rating. Assuming that the motor is between 7½ and 15 h. p., there would be about 11 amperes input per phase at 500 volts for 10 h. p. output from the motor, this figure being based on ordinary power factors and efficiencies. If the motor were appreciably larger than this, say 75 or 100 h. p., it is evident that its current consumption for 10 h. p. output, due to the low power factor of a motor, and that a large one, working at about only 10 per cent. of its normal rating, would be much larger than this, perhaps running up to 25 or 30 amperes. In other words, the question comes down to this, viz., you cannot tell, except approximately, the amperes input for a given horse power output, or conversely, the power output for a given current input, unless you know definitely the power factor and efficiency of the motor when working at any given load.

2. The other day I was experimenting with a separately excited direct current motor, and found when operating it off a series wound generator that it would keep reversing its direction of rotation, running first one way and then the other. Can you explain why this is?

Ans.—This phenomenon, which is somewhat curious, can be discussed as follows: Assuming the motor running in any given direction it is evident that the current flowing through its armature, and which is, of course, also that flowing through the armature and field of the generator, it being series wound, tends to continually increase the speed of the motor. This means an increase of its counter E.M.F., which in turn means a decrease in the current flowing, this resulting in a decrease of the voltage generated by your series wound generator, which latter quickly becomes nil. The momentum of the motor armature will, however, keep it going for a time sufficient for it to send a reversed current through the generator, which means that this latter will immediately start to build up again, but of course with its polarity changed. This in turn means a reversed current through the motor, which latter must therefore immediately stop and then start to run again in the opposite direction; the operation repeating itself indefinitely. You should note that the motor must be rather lightly loaded, or else reversal will not take place, because if the motor has more than a certain amount of load to drive its speed cannot rise high enough to enable it to generate a counter E.M.F. greater than the generator potential.

3. What is meant by the term core loss?

Ans.—It is the name given to the losses in the iron or other magnetic medium of any piece of apparatus, as distinguished from the copper losses, the iron or body of a generator or transformer being often spoken of as the core, whence the name. It is composed of two distinct parts, namely, the losses due to foucault or eddy currents, and the losses due to hysteresis. They both depend on the frequency, the density of the magnetic flux, the amount of core which is to be magnetized, the quality of the iron or other material composing it, and the thickness of the laminations. The hysteretic losses vary directly with the frequency and as the 1.6th power of the density, those due to eddy currents being proportional to the square of both the frequency and the density.

4. Looking over some old numbers of your papers to-day, I noticed a question by "Reader" (on page 212, December, 1902) which reads as follows: "What changes are necessary to make a 110 volt wattmeter suitable for use on a 52 volt circuit, and vice versa, to make a 52 volt instrument register correctly on a 110 volt circuit." Regarding the second point in the answer given, I do not agree with you, for the following reason: The meter will take double the number of watts in the the shunt circuit, which will amount to considerable provided that there are many changed in that way. The total resistance of the shunt circuit in a 50 v. meter is, approximately, 500 ohms, so that the meter should take 50/500 = .1 amp. .1x50 = 5 watts. By doubling the resistance on a 100 volt circuit this would be 100/500 x 2 = .1 .1 x 100 = 10 watts, which is double that it should take. In order to change the meter properly the armature, compensating and resistance coils should be changed and a new armature, etc., installed in their places of the following resistances: Armature, 500 ohms; compensating coil, 300 ohms; resistance coil, 1,200 ohms; total resistance, 2,000. The meter will now take 5 watts in the shunt circuit. Regarding the changing of the "Constant" I find that it is better to partially de-magnetize the permanent drag magnets and leave the constant as it was when it left the factory, as the meter runs more accurately with higher torque."

Ans.—You are correct in your statement that as far as efficiency is concerned, the proper way to compensate for the change in voltage is to have the potential windings altered all through, but this would involve sending the instrument to the factory, recalibration, etc., which is evidently not what our correspondent wanted, or else he would at once have handed it over to the manufacturers with instructions to make the necessary alterations, without asking us any questions about it. We gave him information on the simplest possible method, involving little chance of error and requiring no material but that purchasable from any supply dealer. Regarding the change in the constant, it is evident that if you do not alter the meter proper in any way, simply adding external resistance, you must vary the constant directly with any variation in the resistance of the potential circuit, or else your dial will not give a correct reading. Regarding the weakening of the retarding magnets we would point out to you that the full load speed of any meter is set by the makers at the point which they consider most advantageous; if you appreciably weaken the magnets you correspondingly increase the speed, and you may thus, when the load on the meter approaches its rated capacity, get above a reasonable rate of rotation.

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Conductor, F. W. SCUTTHORPE, -	Hamilton, Ont.
Door Keeper, J OGLE,	Brantford, Ont.

Origin of Fires. As in all other cases where the origin of a fire is uncertain, and there was any sort of a wire within or even near the burned building, the blame for the Iroquois theatre fire in Chicago was promply placed on the electric equipment. "The cause of the conflagration is not known, but it is thought that it was due to a leak from the electric wires," the despatches run, and the public generally, knowing nothing and thinking nothing but that set before them,think so too, and then go about their daily duties, in many cases congratulating themselves on being free from such awful risks, their illuminant being gas. That this is strictly true is often evident when reading the daily press reports on even the most elementary of electrical matters. There is no power, heating or illuminating agent known as yet which, improperly handled, does not contain a large element of danger to both life and property ; on the other hand, if installed with modern appurtances and handled with reasonable care, all the various agents in use to-day are perfectly safe, electricity no more nor less so than any of its confreres. Why then should it be selected, as it almost invariably is, as the scapegoat for almost everybody's incompetence or carelessness ? If the truth were told the wonder is not that there are so many electrical fires, but rather, when one sees the average material and workmanship obtaining in so many situations to-day, that they are not multiplied many times over. This is especially true of theatres in which electrical effects are now generally used and where, the time being short and the work being temporary, there is great temptation to install it in more or less of a hap-hazard manner. Further investigation of the fire in question shows that in all probability it was due to the ignition of some scenery, naturally highly inflammable, which had been forced against a lamp globe, surely not only a dangerous condition, but one in which the chances of fire were practically certain, and blameable, not on any inherent danger or defect in the system employed, but on the rank carelessness which allowed such a state of affairs to exist. To say that this fire was of electric origin is equivalent to that case cited in support of the theory that an ordinary 500 volt railway circuit was dangerous to life, investigation showing it to be true that a passenger had been killed, as was to be expected when he stuck his head in front of a switch stand.

250 Volt Systems. It is strange that when making choice of a mixed lighting and power plant for a moderate sized installation that the merits of a plain two wire 250 volt continuous current plant are so often overlooked in favor of some other system which often proves more costly to install or more expensive to operate, in many cases both. Considering first the question of prime generating plant cost, it will be seen that such an installation will be cheaper than a three wire 115-230 volt equipment, whether the latter be composed of 125 volt machines connected 3 wire, 250 volt generators with a balancer set, or 250 generators with collector rings and the other appurtenances necessary for obtaining a neutral from them. It will also be seen that the wiring throughout the plant, including also a large part of the switches and cutouts, must of necessity cost less, seeing that it really consists of a three wire network minus the neutral. Again, the switchboard will involve less outlay, for the same reason. On the score of simplicity and reliability, no three wire equipment ever installed can compare with a two wire, there being no question of balance, fewer fuses to look after and no damaged lamps owing to interruptions to the neutral. As far as efficiency and maintenance are concerned, the 250 volt still has the advantage at many points; for instance, if the current is commutated but once there must obviously be less loss than if that process is gone through twice or three times. Again, the larger machine with its engine is more efficient than a combination of the same with a balancer set, or else two units each of half the size. Further, the slower speed and the smaller amount of apparatus will result in lower maintenance accounts. Against the foregoing advantages there must be set the fact that with two separate generators running three wire you have a certain amount of reserve in case of trouble with either unit, as the two outside wires can be paralleled and a load equal to the output of one machine can be temporarily operated. All 220 volt motors, however, will be shut down. Another point is that if variable motor speeds are desired you cannot obtain them quite as economically as from two voltages, though the value of the point depends greatly on the purpose for which the plant is operated. A further disadvantage is the poor results obtained from 250 volt arc lamps, which give rays of unsuitable color, besides which they have to be of low amperage, to keep the watt consumption within bounds. Incandescent lamps as commercially built for this voltage have a shorter life than those of lower potential, or conversely, they have to be built of lower efficiency to obtain as long a life. From the foregoing it will be seen that while the 250 volt two wire system has its disadvantages, it on the other hand has many points which render it superior to any style of 125-250 volt three wire, and which will repay careful consideration on the part of those contemplating the installation of an isolated plant of moderate size.

Transformer Lay-out.

In the early days of the electric business, when apparatus was put in almost entirely without question as to its efficiency or arrangement, it was but natural that the methods pursued and the results obtained, viewed in comparison with the practice of the present day, should both be far behind the standards now obtaining. Unfortunately, however, an inspection of the various plants which are scattered throughout the country, especially those of medium size, reveals the fact that but a small percentage of them have made any effort to improve upon the standard of plant design and construction to which they were first built, and that consequently they are now far behind in very many of the points most essential to a reliable and economical equipment. That this should be true is all the more curious when it is considered that many of them, while paying more or less attention to the more obvious method of increasing their net earnings, namely, by enlarging their gross returns, practically entirely neglect the other way, almost equally efficacious, namely, of reducing their operating expenses.

One of the means towards this end, and one which positively obtrudes itself upon those who will take a glance at the average line and transformer equipment of an alternating plant, is the replacing of the many small and old style transformers, which will ordinarily be found in use, together with a multitudinous array of all sorts and descriptions of wires, by a much smaller number of larger units and a substantially constructed secondary network, of a gauge sufficiently heavy to allow for a considerable increase in the load. The advantages resulting from such a change will be many; perhaps the first and most noticeable will be the reduction in the core losses. In the first place the replacement of the old style transformers, and samples are to be found everywhere, even if an equivalent number of late design were put in, would reduce this item to an astonishing extent, the early types having core losses which probably average four times those obtaining to-day. Further, if instead of putting in the same number of small sizes, larger units of the same total capacity were installed, there would be still another gain, as these losses in the latter would be only one-half to two-thirds those in the smaller sizes. Again, the grouping of the equipment onto a heavy secondary, as against a house to house distribution, means that the fluctuations in the load of any given transformer are going to be much reduced, so that each one can be made of a size somewhat approaching the average requirements of a house, instead of having to take care of the maximum, which means that the total transformer capacity can be reduced, with its corresponding gain in reduction of losses. When it is remembered that core loss is virtually an absolutely constant drain on the system irrespective of the load, that it varies from 1½ to 5 per cent. of the transformer capacity, and that current costs all the way from two to five cents per kilowatt hour, or more, the importance of the point and the possibilities which it offers for improvement, or otherwise, are very manifest.

There are, of course, several other advantages resulting from such a change, not the least among them being the superior regulation possessed by modern designs, and by the larger sizes as compared with the smaller. This not only means a better service from the customer's point of view, but also allows the use of higher efficiency lamps, which in turn means a further reduction in the station load. A general overhauling and reconstruction of the system will also give an opportunity to take advantage of this principle, viz., if there be a choice between copper or transformers, that is, if they cost approximately the same, unhesitatingly put in the copper. The reason for this will be apparent when we consider as an example a certain district which can be fed say by five six kilowatt transformers and a given amount of secondary, or by three of ten kilowatts each, and a larger quantity of copper. The three transformers will obviously cost less than the five, and so, even though we have to expend the difference in copper, the depreciation will be less with this equipment than with the other, as will also the core loss; obviously, then, it is the one to install.

The Council of Frederiction, N.B., has granted authority to the People's Light & Power Company, a newly organized local concern, to erect poles and install an electric light plant in consideration of their undertaking to light the city buildings free of charge for a period of ten years. The company will proceed to install the plant at once.

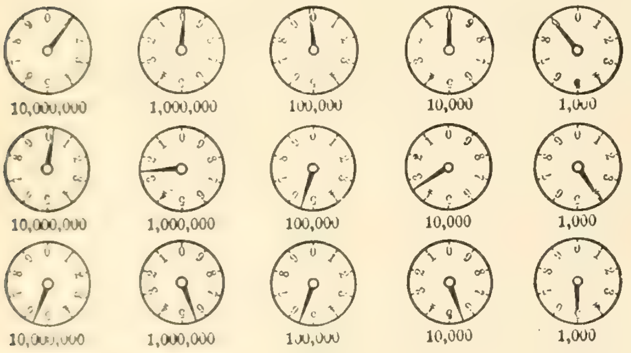
READING METERS.[*]

Meter reading is a simple operation, yet many fail to grasp the relations of the hands of the dials to one another in such a way as to avoid making mistakes in taking a reading.

The majority of meters have five circles composing the dial face, and each circle is divided into ten divisions. Under or above each circle is marked the amount of energy each one indicates in a complete revolution. These units are usually expressed in watt hours, and the lower right hand circle is usually marked "1,000 watt hrs.," indicating that one revolution of this circle registers 1,000 watt hours, and each division in it 100 watt hours. The next circle, reading from right to left, will be marked 10,000 watt hours, and so on in multiples of ten to the last circle at the left hand side of the dial face. Therefore, reading from right to left, each circle indicates ten times the amount of its predecessor, hence each division on a circle indicates an entire revolution of the preceding one. If this relation be borne in mind it is alalmost impossible to make a mistake in reading the meter, even if the hands be slightly misplaced. The hands on the first, third and fifth circles turn clockwise, and on the other two counter clockwise, which leads to confusion with a beginner when first attempting to read a meter.

The reading is started with the dial indicating 1,000 watt hours and the indication of the hand put down at the nearest 100 watt hours. The second circle is likewise marked down, the number being placed to the left of the first circle's indication. The third, fourth, and fifth dials are likewise recorded.

The relation of the dials to each other must be borne in mind when reading, and it must be remembered that, when a hand stands between two numbers, the last one passed is the one to record.



FIGS. 69 (TOP ROW OF DIALS), 70 (MIDDLE ROW) AND 71 (BOTTOM ROW).

The subject can be better explained by means of examples, a few of which are herewith given.

In Fig. 69 we have 900 watt hours registered as the first circle and the hand of the second dial apparently on 0. It is evident that this cannot be on zero, as the space from 9 to 0 represents one whole revolution, circle 1; hence, we read this 9,900. In dial 3, the hand is again on zero, but it cannot be actually zero as the previous dial did not complete a whole revolution, therefore we read it 9, and the reading stands 99,900. Circle 4 is read 9 in the same manner and the total reading is 999,900. On the fifth circle the pointer is on 1, but, as dial 4 did not complete its revolution, we read this zero. It is very easy for any one not bearing in mind the relation of the different circles to each other to make this dial read 1,000,900 watt hours.

In Fig. 70 we have a very easy reading—253,400 watt hours, and in Fig. 71 a succession of 5's, making reading 5,555,500 watt hours. As 1,000 watt hours is one kilowatt hour, the total indications of the dial face with multiplier 1 is 10,000 kilowatt hours.

After one becomes familiar by practice with reading meters, the dials may be read from left to right with facility, but the safer way is from right to left. Nearly all meters have multipliers in the larger sizes by which the indication on the dial face is multiplied to obtain the number of watt hours that has been used. In some of the small sizes, the indication of the dial face is multiplied by a fraction to obtain the true watt hours.

Some manufactureres, instead of using a multiplier for different sized meters, change the relation of the worm gear reduction between the dial train and the revolving armature shaft in order to make the dial face always read directly in watt hours. This practise is to be commended, as it tends to simplify the records and eliminate errors by getting the wrong multipliers recorded through oversight.

Ampere hour meters have dial faces which indicate ampere hours instead of watt hours. The readings are taken in the same manner as described for watt hour meters.

The majority of consumers of electric current, particularly store keepers, mill owners and factories, would like to know how to read their meters and figure out the bills from the readings. A knowledge by them of their daily consumption of current would enable them in many instances to institute economies which would result in a material reduction in their lighting or power bill.

We will suppose, for example, that the reading of the meter on May 1st was 986,600 watt hours, and on May 10th it was 1,230,600 watt hours, the consumption of current for the ten days would be 250,000 watt hours, or 250 kilowatt hours. To obtain the bill, the kilowatt hours are multiplied by the amount charged per kilowatt hour, which we will suppose to be ten cents. Twenty-five dollars ($25.00) would be the required bill. If the dial face carried a multiplier, the consumption would have been multiplied by it and then by the price per kilowatt hour. Whether for light or power the bill would be determined in the same manner.

As a 16 c. p. lamp, when burned for one hour, registers 50 watt hours on the dial face, a rough estimate can be readily made by the consumer to ascertain the correctness of his meter. If ten 16 c. p. lamps are turned on for one hour, the meter will register it correctly, 500 watt hours. A percentage fast or slow would be readily noticeable in a reading of this size, and the consumer in this way can satisfy himself as to the correctness of his meter. If this were more universally done, much idle complaint by the consumer would be avoided.

To facilitate the duties of the meter reader, a meter slip carrying blank dial faces is used, and the indications of the hands are marked down as they appear. This serves as a check on the reading recorded, and enables a "checker," when the slips are turned into the office, to verify the correctness of the reading. After a dial face has been in use for some time, the fifth circle at the left hand may complete a total revolution between readings. In that event, the previous reading is subtracted from 10,000,000, and the reading found on the dial when read will be added to the amount thus obtained. In other words, the dial will have started all over again. This frequently happens, and sometimes leads to confusion in the mind of the consumer.

THE OTTAWA ELECTRIC RAILWAY.

The annual meeting of the Ottawa Electric Railway Company was held on January 25th. The tenth annual report showed that the gross receipts for the year were $348,888.78, and the expenses, including interest on bonds, taxes and track mileage, $254,346.96, leaving a net profit of $94,541.82, or nearly 11 per cent. on the average capital stock.

Four quarterly dividends of two per cent. were declared, amounting to $69,284.07, leaving a balance of $25,257.75, of which $20,200 was placed to the credit of contingent account, to be applied to the reduction of car equipment account, new track expenditure on Bank and Rideau streets, and other items. The balance of $5,057.75 was placed to the credit of profit and loss.

The amount paid to the city for track mileage was $8,881.48. The cost of snow clearing for the year was $14,485.61. The number of passengers carried during the year was 7,911,718.

The following were elected directors for the current year: T. Ahearn, Warren Y. Soper, Alex. Lumsden, Thomas Workman, Peter Whelen, George P. Brophy, and Hon. Geo. A. Cox.

At a subsequent meeting of the directors Mr. Ahearn was elected president, Mr. Whelen vice-president and Mr. James D. Fraser secretary-treasurer.

Mr. F. S. Pearson, the well-known engineer, Mr. F. L. Wanklyn, and other Canadian capitalists, have been in Mexico for some time, where 2,500 men are now engaged in the constuction of an electric plant for the Mexican Light & Power Company. The site of the plant is at Necaxa, in the State of Puebla, 90 miles from the City of Mexico, to which city power is to be transmitted. The initial development is expected to be 45,000 horse power, which will ultimately be increased to 80,000 horse power. Owing to the inaccessibility of the site of the generating plant, it was found necessary to build a wagon road up the side of a steep mountain, a distance of several miles, so that heavy machinery could be transported. Eight tunnels will have to be constructed through the mountains to bring water to the power station. It is reported that the contract for the generators has been placed in Germany.

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[*] Reprinted by permission from "American Meter Practice," by Lyman C. Reid, published by McGraw Publishing Company, New York.

NEW OFFICIALS OF THE MONTREAL STREET RAILWAY.

A number of important changes in connection with the Montreal Street Railway Company were announced recently. Mr. F. L. Wanklyn, vice-president and general manager of the company, has resigned both of these positions and has become vice-president of the Dominion Coal Company and will probably take an active part in its management. Mr. K. W. Blackwell has succeeded Mr. Wanklyn as vice-president of the Montreal Street Railway, and Mr. W. G. Ross, late secretary, has become managing director. Mr. Duncan McDonald has been appointed general manager and Mr. Patrick Dubee becomes secretary.

Mr. W. G. Ross, who becomes managing director of the Montreal Street Railway and the Montreal Park & Island Railway, was born in Montreal on the 6th August, 1863. For over twenty years he has been an accountant and auditor, having been associated with his father in that capacity as early as 1880. In the eighties he was successively secretary-treasurer and assistant manager of the Windsor Hotel Company. In 1892 he became associated with Mr. Jas. Ross, who was active in developing Canadian street railways, and who entrusted the organization of the financial end to Mr. Ross. He has been successively comptroller and secretary-treasurer of the Montreal Street Railway Company. He also occupies the position of treasurer of the Mexican Light & Power Company and is director in various other companies. Mr. Ross was one of the organizers of the Street Railway Accountants' Association of America. He was until recently second vice-president of the Montreal Light, Heat and Power Company, and upon his resignation from that office was tendered a banquet at the Windsor Hotel by the officials of the company.

MR. W. G. ROSS,
Managing-Dieector Montreal Street Railway Company.

Mr. K. W. Blackwell, who becomes vice-president, is a mechanical engineer of no mean reputation, having held responsible positions on the Grand Trunk, Chicago and Grand Trunk, and Canadian Pacific Railways. He later retired from this profession to enter business and he is now president and managing director of the Montreal Steel Company.

Mr. Duncan McDonald has seen twenty odd years of service in the old City Passenger Railway and the Montreal Street Railway, coming up from the ranks to his present position. When the time came to reconstruct the old City Passenger Railway upon modern lines, Mr. McDonald proved invaluable. He resigned the general superintendency of the company to take up a position with the Traction Company of Paris, which he resigned some little time ago to come back to the Montreal Street Railway as assistant general manager.

Mr. Patrick Dubee, the secretary-elect, has been in the service of the company since he was a boy of fourteen. Under the old regime he was closely associated with the late Mr. E. Lusher, secretary. When Mr. Ross was advanced to the secretaryship Mr. Dubee was made assistant.

MR. N. S. BRADEN.

Mr. N. S. Braden, who succeeded the late Thomas C. Frenyear as sales manager of the Canadian Westinghouse Company, Limited, on January 1st, has been connected with electrical industries since 1892 and identified with the Westinghouse interests for the last four years. He is known as one of the best informed electrical salesmen in America, and his being placed in charge of the sales department of the new Canadian Westinghouse Company is sufficient proof of his energy and success in his chosen work.

Mr. Braden was born in Indianapolis, Indiana, thirty four years ago. After finishing a special course of study in Whitman College, at Walla Walla, Washington, he joined the Jenny Electric Motor Company, of Indianapolis, Ind., in 1892, where he remained for several years. In January, 1899, he became a salesman for the Westinghouse Electric & Manufacturing Company at Cleveland, Ohio, and was manager of that office at the time of the death of Mr. Frenyear, whose place he has now taken. Mr. Braden's office is at Hamilton, Ontario.

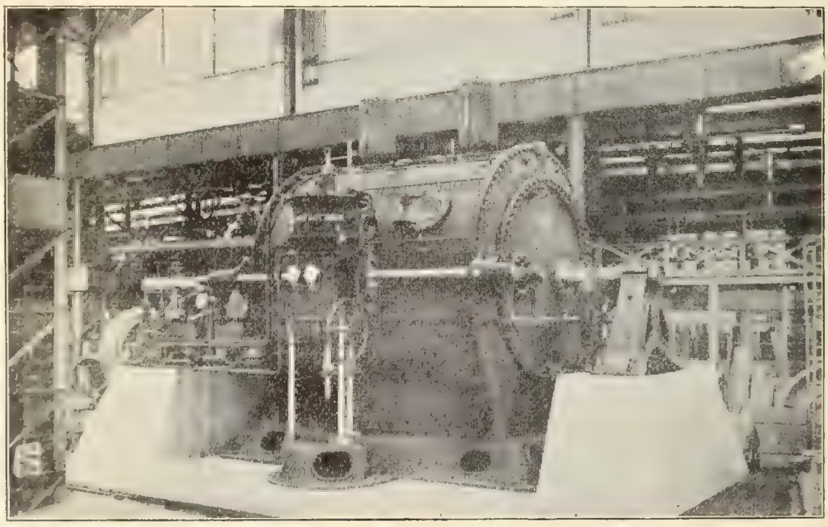
MR. N. S. BRADEN,
Sales Manager Canadian Westinghouse Company.

The Manitoba Electric Engineering & Supply Company, of Winnipeg, has been incorporated by Messrs. R. L. Tucker, A. L. Boucher, C. E. Taylor, R. S. McWatters and J. M. Lowe.

Hon. J. M. Gibson has presented to the Ontario Legislature a petition for the incorporation of the Hamilton, London & Lake Erie Railway Company, to build an electric railway from Hamilton to London, St. Thomas, Strathroy and other places in western Ontario. The promoters include Messrs. H. C. Osborne and G. L. Francis, stock brokers, of Toronto, Lloyd Harris, capitalist, of Brantford, and Albert Carl Frost, banker, of Chicago.

EXTENSION OF SHAWINIGAN FALLS PLANT.

The Shawinigan Water Power Company, which transmits electric power from Shawinigian Falls, Que, to the city of Montreal, has recently made some important extensions and improvements, and others are in contemplation. It has been found that the quantity of power available is greater than was at first estimated, and no doubt the total flow will be utilized in the near future. The illustration shows a new turbine of Swiss manufacture recently installed. It has a capacity of 6000 horse power and operates under a net fall of from 125 to 135 feet, consuming 508 feet of water per second. It turns at a speed of 180 revolutions per minute and is of the horizontal-shaft type constructed by Escher, Wyss & Company, of Zurich. It is directly connected to a two-phase electrical generator of 3,750-kilowatt capacity. This polyphase alternator was constructed by Dick, Kerr & Company, of London and Preston, England, for whom the Canadian agents are Campbell & Renton, of Kingston, Ont. It is a revolving-filled machine, with a cast-iron spider, the hub being arranged with a flange for bolting to the turbine. Laminated steel is used for the pole pieces, held together between two capped steel end plates. The machine has a freuqency of 30 cycles per second and operates at a pressure of 2,000 volts.



New 6,000 Horse-Power Swiss Turbine in Shawinigan Falls Power House.

The Shawinigan Company recently closed a contract with the Sorel Electric Company for the delivery of power at Sorel, Quebec, and the transmission line to deliver the current has been completed. To meet the requirements, a transformer station was built at Joliette, where the 50,000-volt current from the main line is stepped down to a voltage of 12,500. A line was then built from Joliette to the banks of the St. Lawrence River near Lanorale, following the right of way of the Canadian Pacific Railway. Across the St. Lawrence the current is carried by a submarine copper cable, heavily insulated and armored with lead and steel wire. On the south side of the river the line follows the public road until it reaches Sorel. Necessary steps have been taken to obviate danger from the river current or pressure of ice in the spring. Aluminum cable has been used throughout, this cable being manufactured by the Northern Aluminum Company, at Shawinigan Falls, the whole line being of much lighter construction than that employed in the main transmission line. The construction work was carried out by Messrs. Johnson & Saunders, contractors, of Buffalo, N. Y., the submarine cable having been supplied by the American Steel & Wire Company, of Worcester, Mass.

The agreement with the Montreal Light, Heat and Power Company stipulated that when the latter company took five thousand horse power of Shawinigan power a second transmission line should be built. This quantity was reached a short time ago, and the Shawinigan Power Company are now completing arrangements for the building of a duplicate line from Shawinigan Falls to Montreal, with a capacity of ten thousand horse power. It is also understood that the Sorel line is only the beginning of a series of short lines which will tap the main lines and carry power to points between Shawinigan and Montreal, a distance of eighty-five miles.

THE STORAGE BATTERY IN SMALL CENTRAL STATIONS.*

By J. M. S. Waring.

Owing to the impossibility of drawing any distinct line separating storage-battery practice in small central stations from that in the larger stations, and to t [illegible] that many or most of the economies and advantages effected are common to all direct current stations, irrespective of their output, I have decided to deal with this subject in the following way :

First, to cite a battery application peculiar to small stations, and then to dwell briefly on the features common to all central stations.

In the first case, the consideration will be that of a lighting station in a small village. In some cases it usually proves unprofitable to furnish continuous service throughout a 24-hour day, as the demand for current during the early morning hours and throughout the greater portion of the day would be so small that the additional shift of men required and the increased fuel consumption on the plant would prohibit the commerical succes of the venture.

It is, however, true that the manager of a central station operating only a night schedule is greatly handicapped. In order to secure any great amount of residential-lighting business continuous service must be supplied, as the owner of a residence would naturally demand light during all hours of the night, and would further probably desire fan service throughout the day during the summer months. If these facilities cannot be offered to the public the amount of business of the small central station is necessarily limited.

As an illustration of what has been accomplished along this line I might cite a case in actual practice where the conditions were as follows : The plant I have in mind consisted of one 60 and one 120-horse power non-condensing engine, which in addition to driving certain machinery, operated two 125-volt generators, one having a capacity of 20 and the other of 25 kilowatts, the two being operated in combination on a three-wire Edison system, with 220 volts across the outside mains. This plant had been operating and supplying a load concentrated within a very small radius. By referring to the accompanying sketch you will notice the nature of the load at this time, the dotted line (curve 1) being the load curve. The maximum peak load, of 150 amperes, was on the station for about an hour and a half in the evening—that is, from 6.30 until 8; it then gradually decreased to about 10 amperes at 11 o'clock at night, and at 12 the plant was shut down.

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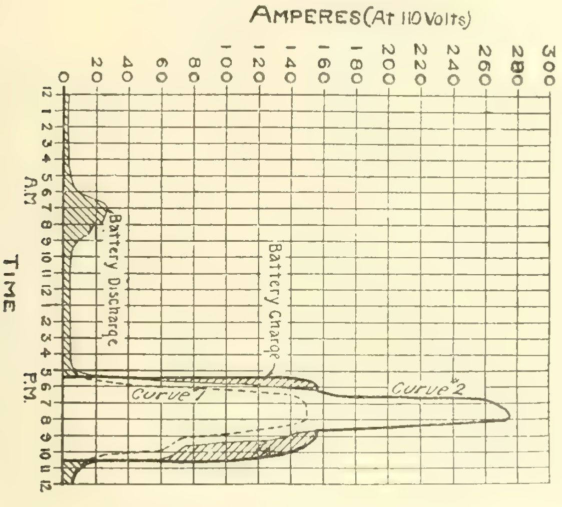
*Paper read before the Northwestern Electrical Association, at Milwaukee, on January 21, 1904.

An opportunity arose for this plant to obtain the contract for city lighting, but the cost of the necessary transmission line, including poles, copper, etc., amounted to so much that the returns from the city lighting alone would not warrant the investment; however, it was obvious upon investigation that if a sufficient mount of residential lighting could be assured the investment would become a decidedly paying one, and with this in view a storage battery was installed. This installation made, the station continued to operate for the same number of hours daily. On account of the new business the load was increased to an amount illustrated by curve 2 of the sketch. The shaded portion on each side of this peak shows where the battery was being charged while the station was in operation, and from 12 o'clock (midnight) until dusk in the afternoon the entire load was taken care of by the battery.

While this was a three-wire system, with 220 volts across the outside mains, only a 110-volt battery was installed, for, during the hours that the battery was operating the load was so light that by connecting the two outside mains together at the station the system could be operated by a two-wire 110-volt system, and even under these conditions, owing to the light load, the drop was considerably less than when operated as a three-wire system with the maximum load. In this case there was an increase in load after the installation of the battery of about 66⅔ per cent. and an increase in fuel consumption of only about 25 per cent., showing that the cost of fuel per kilowatt-hour was decreased about 37½ per cent., this decreased fuel consumption being due to the fact that the generator set, while operating with the battery, was run at a considerably higher percentage of full load than was the case before, the efficiency being correspondingly increased.



LOAD CURVES OF SMALL CENTRAL STATION.

Another instance which occurrs to me is similar to the above, with the exception that the plant supplied the adjacent district from a three-wire direct-current system, while in the outlying districts the load was on an alternating system. While this alternating load was exremely heavy during the peak it was very light during the day, consisting only of a small amount of fan service in the summer months. A battery was installed in this plant which furnished current directly to the direct-current mains and at the same time operated a direct-current motor running a small alternator so that the fans on the alternating-current system could be operated. These and cases of a similar nature are, of course, confined to very small plants. Another application of the storage battery, which is irrespective of the size of the plant, is that of a battery operating in conjunction with a waterpower plant. A number of cases have come before the attention of the writer where there was sufficient waterpower to supply considerably more than the load existing during the greater portion of the 24-hour day, the peak load during the evening hours, however, being in excess of the capacity of the turbines. In this case the value of the battery is apparent, as the generators while carrying the day load are charging the battery at the same time, the battery assisting to the extent of its capacity during the peak, thus giving an increased station capacity, which would otherwise be only obtainable by the addition of an auxiliary steam plant, with a correspondingly increased cost of operation, which would probably make the investment prohibitive.

There is a number of features which may now be briefly mentioned as being of interest to the central-station manager regardless of the size of the plant he is operating.

To the central-station manager a minimum cost of production and transmission, allied with reliability of service, are essential. The consumer, however, demands that the latter item be not sacrificed in the pursuit of economy. Intermittent service results in a loss of business to the central station, and, while it may be difficult to compute the expense to which a lighting station is subjected by a 10 or 15-minute interruption, the official who receives the complaints of his customers fully realizes that a loss of revenue does result from frequent recurrences of this complaint. The storage battery insures increased economies of production and transmission, at the same time almost entirely preventing interruptions to service. A battery at the source of the direct-current transmission—that is to say, in either a direct-current power house or a rotary sub-station—will offset, in the first place, the installation of a corresponding capacity of boilers, engines and generators. In the second case—that of a rotary sub-station—in addition to this apparatus it will also offset a certain proportion of the static transformers and rotary equipment, with the cost of which apparatus that of the battery will compare favorably. It is of the greatest value as a reserve in either case, tiding over shutdowns occasioned by trouble on any of the apparatus just mentioned, or in the high-tension line in the latter case. The battery, being ever present on the system, is readily available as a reserve. It further obviates the necessity of carrying boilers under steam in anticipation of a peak load, thus insuring a decreased fuel consumption.

Another familiar application of the storage battery is that of placing it at the center of a load on a direct-current system of distribution. When the volume of business in a congested locality covered by a low-tension system of transmission reaches a certain amount (and the more remote this locality from the central station the sooner this point is reached), the amount of copper required to care for the power from the central station necessitates an outlay tending to render this system of transmission prohibitive. By the installation of a battery of a capacity sufficient to care for a certain portion of the peak the amount of copper between the central station and the center of load is decreased to such an extent that the battery investment is decidedly the preferable one from a commercial standpoint.

One of the more recent adaptations of the storage battery, and one whose importance will readily be recognized by central-station managers, is its use in connection with the direct-current exciters in alternating-current power and lighting plants. With an installation of storage batteries floating at all times on the exciter bus, interruptions of current in the exciter circuit are practically obviated. Reduced fluctuations of the exciter voltage are assured, together with corresponding reductions in the alternating-current voltage fluctuations. Where alternating-current motors are used to drive the exciters the battery also serves to supply field current when starting up the plant after a shutdown. An attractive feature in the battery installation is its adaptability to changes of conditions over a very wide range. Its capacity or voltage may be increased or decreased by varying the number of plates per cell or the number of cells in series without effecting in any way the original installation, thus obviating the necessity of anticipating any future increase in business.

In may be said in general that there are few direct-current systems on which the service may not be improved, the liabilities of interruption decreased and the operating expenses minimized by the use of a storage battery auxiliary.

THE TORONTO RAILWAY COMPANY.

Reports submitted to the directors of the Toronto Railway Company at their annual meeting on January 20th, showed that for the first time the company's gross earnings had passed the two million mark, totalling $2,172,087.85, an increase of $337,179.48. The number of passengers carried increased from 44,437,678 in 1902 to 53,055,322 in 1903. The number of transfers increased by 2,680,123. The operating expenses were $1,200,823.39, as compared with $1,015,361.32 in 1902. The proportion of operating expenses to earnings is the same for both years, being 53.3 per cent.

The only change on the board of directors was the election of Mr. J. G. Grace to succeed Mr. James Ross, of Montreal, he having resigned.

The Canadian Westinghouse Company, Limited, have established a branch office at Vancouver, B.C.

OFFICERS OF THE ENGINEERS' CLUB OF TORONTO.

Of the younger engineering organizations in this country, perhaps none have done more to encourage a spirit of good fellowship among the members of the profession than the Engineers' Club of Toronto. Organized early in the year 1899, it has now a membership of 139, embracing persons engaged in all the different branches of engineering. While the social side of the Club has been developed, the question of educational advancement has not been overlooked, as many valuable papers and addresses on engineering subjects have been delivered at the regular meetings. We present herewith the officers for the current year.

CAPT. KILLALY GAMBLE.

Capt. Gamble, the president of the Club, was educated at Portora Royal School, Ireland, and the Royal Military Academy, Woolwich. He was gazetted Lieutenant of Royal Artillery in 1866 and served at home, in the Mediterranean, and in the West Indies. He commanded the Royal Artillery in the Bermudas in 1880. The Captain retired from the service in 1882, and after serving for a short time on railway work, under Mr. James Barton, C. E., in Ireland, he came to Canada and settled in Winnipeg. He became a Provincial Land Surveyor for Manitoba in 1886 and a Dominion Land Surveyor in the same year. Removing to Toronto he became an Ontario Land Surveyor in 1888, and in 1902 was appointed secretary-treasurer of the Associaton of Ontario Land Surveyors. He has always taken an earnest interest in the Engineers' Club, having served as a director in 1902 and as second vice-president in 1903.

MR. R. F. TATE.

Mr. Robert Frederick Tate, Mem. Can. Soc. C.E., has for the past four years been resident engineer for Mackenzie, Mann & Company, Limited. He began his professional career as rodman on the Midland Railway (now a portion of the Grand Trunk Railway System) in 1871, and since that time has obtained a railway engineering experience covering all branches. He remained in his first position ten years, completing the construction of the line to Midland and laying out and constructing the first yards, docks and elevator sites at that port. During the last five years of his connection with the road he was chief engineer. Mr. Tate has since been engaged with the principal Canadian railways in charge of location, construction and chief of construction offices in design and general work pertaining thereto. He was with the Grand Trunk Railway as resident engineer in charge of double track construction and a branch to the Sarnia Tunnel, and with the Canadian Pacific Railway on their line from Farnham, Que., to Mattawamkeag, Maine, the Smith's Falls extension and the Crow's Nest Pass Railway, as well as surveys for the company. Mr. Tate comes from an engineering family of three generations. He was director of the Engineers' Club in 1903, and is now its first vice-president..

MR. JAMES MCDOUGALL.

Mr. James McDougall, C.E., second vice-president of the Engineers' Club, was one of the first graduates in engineering of the School of Practical Science. From July, 1884, to August, 1886, he was assistant to the late J. T. Stokes, C.E., County Engineer for the County of York, giving his attention to the designing of bridges and to construction of sewers, waterworks, srreet grading and paving in the town of Parkdale. The following year he was engaged in the construction offices of the Canadian Pacific Railway under Mr. W. T. Jennings, being sent to Wingham to take charge of the construction of the Wingham extension. He was later employed on calculations necessary for the final estimates connected with the deepening of the Welland canal. From December, 1888, to September, 1891, he was again employed by the Canadian Pacific Railway, during which time he obtained an experience in all phases of railway work, including surveys, grading, bridges, excavation by train and steam shovel, terminal docks, etc. Early in the year 1892 Mr. McDougall was appointed county engineer for the County of York, in which capacity he has been in charge of various works, beginning with the construction of the Toronto and Mimico Electric Railway, of which he was chief engineer. He has represented both county and companies in the construction of extensions of the Metropolitan Railway from York Mills to Newmarket; the Toronto Suburban Electric Railway to Lambton Mills and extension through Weston; and the Toronto and Scarboro Electric Railway from the beginning to its present terminus. He has also made locations for further extensions of the above named roads and was chief engineer during survey and construction of the Schomberg and Aurora Railway, a steam road but lately opened.

MR. WILLIS CHIPMAN.

The secretary of the Club, Mr. Willis Chipman, is an honor graduate in civil and mechanical engineering of McGill University, Montreal. He first established an office in the town of Brockville, Ont., and in 1881 was appointed town engineer, which position he occupied until 1893. Three years prior to the latter date he removed his head office to Toronto, where he has since been located, conducting a very extensive engineering practice. While he has made a specialty of waterworks and sewerage construction, the scope of his practice embraces all branches of municipal engineering. He has designed and constructed sewerage works for London, Brantford, Brockville, Sault Ste. Marie, Smith's Falls, Campbellton, N. B., and many other corporations. The waterworks systems designed and constructed under his supervision include those for such towns as Galt, Goderich, Gananoque, Petrolea, Smith's Falls, Sturgeon Falls, Midland, Pembroke, Edmonton, Alta., Kamloops, B.C., etc. Mr. Chipman has also been engaged as engineering expert by several cities and towns during the proceedings for expropriating their waterworks. Among these might be mentioned

Barrie, Belleville, Berlin, Cornwall, Moncton, N. B., and Sherbrooke, Que. He has made a careful study of sewage disposal, having during the last ten years inspected the principal sewage disposal works in Canada, the United States and Great Britain. He has recently made an exhaustive report on the extension of the water supply for the city of London. Mr. Chipman took an active part in the organization of the Ontario Land Surveyors Association in 1886, being its first secretary and subsequently becoming president. He has been secretary of the Engineers' Club from its inception, and it is admitted that the success of the Club is in large measure due to the efficient services rendered by him. Mr. Chipman is a member of the Canadian Society of Civil Engineers, the American Society of Civil Engineers, American Waterworks Association, and the Association of Executive Health Officers of Ontario.

MR. WILLIS CHIPMAN.

OBITUARY.

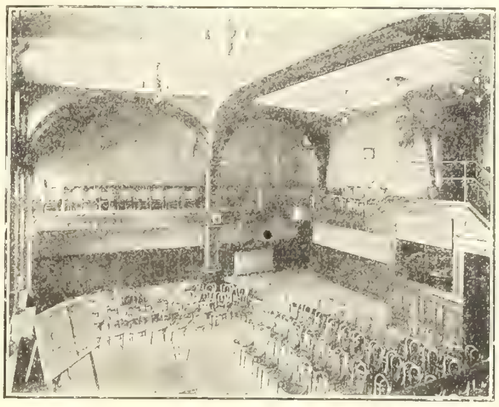
In the January number reference was made to the death of Mr. F. T. Wilkes, secretary-treasurer of the Waterous Engine Works Company, whose portrait is here shown. The loss to the city of Brantford and to the company with which he was associated is felt most keenly. A local writer pays him the following well-deserved tribute :

He came to Brantford when a young man to enter the office of the Waterous Company, and his many splendid qualities soon led to his rapid promotion. For many years he had been secretary of the concern, and in that capacity he rendered valuable and untiring service. With splendid loyalty and never ceasing energy he thoroughly identified himself with the interests of the firm, and at all times he gave of his best. If there was one characteristic of the deceased more than another it was his sense of justice. He expected at all times promptness, efficiency and energy, and that which he looked for in others he rendered himself, full measure, pressed down and running over. Honorable in all his aspirations and dealings, he won the sincere respect and esteem of all with whom he came in contact. As a citizen and friend he was the embodiment of truth and loyalty and all the duties of life were discharged by him with a single and a sincere desire to do that which was right.

THE LATE MR. F. T. WILKES.

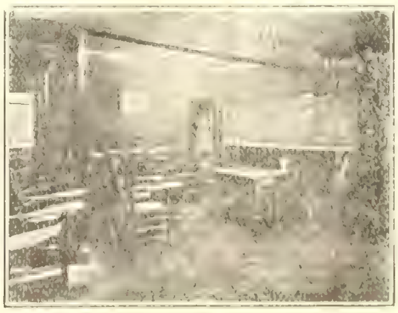
THE ELECTRIC CLUB OF PITTSBURG.

The Electric Club of Pittsburg was organized in March 19, 1902, for social, engineering and physical improvement. The initial membership was 150, consisting principally of engineers and apprentices of the Westinghouse Electric and Manufacturing Company and its allied companies. The club rooms, comprising the whole of the second floor of the Hamnet Building at 735-737 Penn ave., Wilkinsburg, are fitted up in a very suitable manner. They are steam heated, and lighted by means of Nerust lamps. The equipment includes a projecting lantern and screen ; 3 h. p. induction motor, and 1.87 k.w. 125 volt compound generator, direct connected, to be used in connection with the lantern and experiments in class rooms and sections.


Assembly Hall—The Electric Club, Pittsburg.

The working of the Club is in the hands of various committees representing the different sections, such as House Committee, Ladies' Committee, Library Committee, Lecture Committee, Class Committee, etc. The technical work of the Club aside from the general lectures is conducted in sections meeting bi-weekly under the direction of a permanent chairman. The sections now organized with their chairmen are as follows: High Tension Transmission, P. M. Lincoln ; Principles of Alternating Current, S. M. Kintner ; Alternating Current Apparatus, D. F. Rogers ; Transformers, K. C. Randall; Direct Current Apparatus, J. M. Hipple; Railway Work, C. Renshaw ; Switchboards, S.Q. Hayes ; Road Engineering, F. J. Chisholm ; Electrical Testing, A. Pope ; Materials of Construction, T. D. Lynch ; Elementary Electricity, R. D. DeWolf.

Reading Room—The Electric Club, Pittsburg.


A Meeting Room—The Electric Club, Pittsburg.

The Club recently decided to issue a periodical containing the best material presented before it. It is known as the Electric Club Journal, and the initial number just to hand shows it to be of a high standard from the standpoint of both tyhography and contents.

ELECTRIC LIGHTING IN CANADA.

According to statistics compiled by Mr. George Johnson, Dominion Statistician, there were last year 324 electric plants in the Dominion with 14,780 arc lights and 1,212,801 incandescent lights. Taking the arc as equal to 10 incandescent lights the country had on the 30th of June last 1,360,661 lights in use. This is an increase of 236,865 lights in the twelve months, or over 21 per cent. Where there were five lights in 1902 there were 6 in 1903. The growth since 1898 has been : Establishments, 1903, 324; increase, 65. Arc lights, 14,780; increase, 4,391. Incandescents, 1,212,861; increase, 749,246, showing an increase of 42 per cent. in the number of arc lights and of 161.6 per cent. in the incandescents.

Of the provinces Ontario is far away the chief employer of the electric light. This province had 203 of the 324 plants in use in the Dominion. It has considerably more than one-half the total number of arc lights and 47 in each hundred of the incandescents. Thirty-four municipalities in the province supply themselves with electric lighting.

The province of Quebec has 53 plants, 3,853 arc lights, and 409,503 incandescents. It is, therefore, behind Ontario by 4,571 arcs and 158,990 incandescents. It has made, however, greater proportionate gain since 1898 than Ontario, the gain in arcs being : Ontario 36.2 per cent., Quebec 47.6 per cent.; and in incandescents, Ontario 138.6 per cent., and Quebec 212.3 per cent. During the period 1898-1903 the number of plants in Quebec increased by 13.

The largest single plant in the Dominion is that of Toronto, with its 170,000 lamps ; arcs being taking as each equal to 10 incandescents. The next largest is that of the Lachine Rapids Hydraulic and Land Company, Montreal, 158,503. The third in size is the Ottawa Electric Company with 111,927 lights.

The other provinces have made considerable progress. To the west, Manitoba has increased in 1898-1903 its arc lights from 162 to 375, and its incandescents from 13,800 to 31,905.

The North-West Territories have not increased as rapidly as the other parts of the Dominion, their arcs numbering 29, an increase of 4 in the period named, and their incandescents numbering 6,677, an increase of 1,997.

British Columbia shows the largest proportional increase of any of the divisions of Canada, its increase of arcs being 377 or 82 per cent., and of incandescents, 74,297 or 257 per cent. In 1898 British Columbia and Nova Scotia had almost the same number, B. C. having 7 more arcs and 169 more incandescents ; yet Nova Scotia has increased the number of its incandescents by 32,140 or 11.16 per cent. The three Maritime Provinces had in 1898 951 arc lights and 46,977 incandescents, and in 1903 they had 1,267 arcs and 93,120 incandescents, an increase of 33⅓ per cent. for arcs and of over 98 per cent. for incandescents.

Ottawa capitalists are seeking incorporation for a company to construct an electric railway from Ottawa to the town of Buckingham, thence along the River Lievre to James Bay.

The New Brunswick Telephone Company has completed the work of installing new telephones in Carleton and laying a cable across the river from St. John, a distance of about 1,200 feet. An overhead cable has also been run from the telephone office to connect with the river cable, a distance of two miles.

THE TRENT VALLEY CANAL.

"The Trent Valley Canal and the Development of Canadian Waterways" was the subject of a lecture before the Canadian Institute, Toronto, on Saturday evening, February 6th, by Mr. J. Alex. Culverwell, of Peterborough. The discourse was ilustrated by numerous lantern views of the new Erie, the Welland St. Lawence route, the Trent Valley, and the German Canal system, and an interesting description was given of all these systems.

Mr. Culverwell argued that in the Trent Valley system we were following out the method adopted by the German barge canal, completed recently, to connect their coal and steel districts with the north sea, viz., length and breadth of lock rather than depth, seeking bulk of boat in that direction. The draught in each canal system would be the same—eight feet.

New York state also was building a barge route of 1,000 ton boat capacity, only a little larger than the Trent, which will be an 800 ton barge canal, and this enlarged Erie canal, costing one hundred million dollars, would—the State Commission reported—reduce the grain freight rate from Buffalo to New York by two-thirds, which would certainly demoralize the Canadian grain-carrying trade—so the report would prove—as also completely underbid the New York railroad rate possibilities.

The Dominion Marine Association were pressing the Canadian Government to enlarge the Welland Canal from a 2,000-ton lock capacity, so as to enable them to pass a 6,000-ton vessel through to Kingston, and then tranship to 2,000-ton barges for Montreal, and this, too, after first completing an expenditure of $40,000,000 for the present enlargement of the Welland-St. Lawrence Canals. Mr. Culverwell pointed out that ship dimensions in fact had outgrown the Welland-St. Lawrence system years before the enlargement was completed. He advocated expending the five million dollars necessary to complete the Trent Valley route, which now had 160 miles of navigable route bottled up, and thus open up "Nature's short route grain-carrying waterway," as he termed it, pointing out that American marine journals recently openly stated that the Trent Valley route is the only Canadian route they feared.

The speaker also showed that it was a day shorter than the Welland route, and, besides, would give communication between Peterborough, Lindsay, and Central Ontario points with Toronto, Hamilton, and western Ontario, and be the means of increasing the rapid development of the central portion of the province.

Prof. Coleman, the president of the Institute, was in the chair, and there was a large attendance of members, as also some gentlemen interested in transportation matters.

The fifty-seventh annual meeting of the Montreal Telegraph Company was held in Montreal on January 14th. Mr. Hugh A. Allen, the president of the company, presided. The dividend guaranteed by the Western Union Telegraph Company, under the terms of the agreement of August 17th, 1881, was distributed in the usual manner and on the fixed dates during 1903, with a payment of ten cents a share to shareholders of records on March 31st last. The company's property is valued at $2,151,823.85, free from encumbrance of any kind. Mr. Hugh A. Allen was elected president, Mr. A. T. Paterson vice-president, and Mr. D. Ross secretary treasurer.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, February 8th, 1904.

From the large membership of the Civil Engineers' Society some members a few months ago thought that the idea of starting a Club for Engineers would be a good plan. That the move was popular is shown by the existence of the present Engineers Club with quarters on Dorchester street nearly opposite the well known St. James Club. The membership is large and embraces the names of many of the most prominent engineers, civil and electrical, in Montreal. The rooms are fitted up with a view to comfort rather than expensive "show," and a quiet game of bilards, etc., may be enjoyed as recreation for the members, or a good rest in the neat smoking and reading rooms. Mr. P. W. St. George, late city surveyor for the city of Montreal, is president for the ensuing year, with Mr. Stuart Howard as treasurer.

Mr. J. A. Douglas, who has been for some years an esteemed employee of the Montreal Light, Heat & Power Company, where he had charge of their interior wiring department, has severed his connection with that company to assume the duties of superintendent with the Hill Electric Switch Company. Mr. Douglas has been connected with the electrical business for over 12 years in many of its different phases, having been in the employ of the Canadian General Electric Company, Peterboro, T. W. Ness & Company, Montreal Electric Company, and the Royal Electric Company, thus giving him a grasp on various details. Mr. Douglas is energetic and always "on deck" and will likely prove a valuable acquisition to his present employers, the more especially in Montreal, where he is favorably known to the local trade in general.

That the bottom has dropped out of things since New Years is pretty generally admitted by local contractors. No relief is apparently in sight for a month or so, and then when spring building begins it will be in order for some labor union or other (with odds in favor of the plumbers and steamfitters) to hold things up for a bit longer.

The usual annual meeting of the Electrical Contractors' Association was held in the Builders' Exchange quarters on Tuesday, 26th January, at 3 p. m., a good attendance being present. Mr. W. H. Scott, retiring president for 1903, declared the result of the elections for the ensuing year to be as follows: N. Simoneaut president ; Geo. H. Hill, secretary (re-elected) ; Executive Committee, E. W. Sayer (Sayer Electric Co.), R. Moncel (contractor, 140 Peter street), W. B. Shaw (Montreal Electric Co.) The annual report of last year showed that the Association had been of benefit, and the financial statement was satisfactory. The Association intend to repeat their annual dinner at no distant day and means will be arranged that those who wish to attend the event and who do not belong to the Contractors' Association, can do so.

NEW HIGH VOLTAGE OIL FUSE.

Tests of a very satisfactory nature have been made by one of the most important electrical plants in this country with a new high voltage oil fuse which promises to justify its adoption by the superintendents of power houses throughout the country as a means of protection against damage to switch-boards and machines caused by short circuits. It is very simple in construction and is especially adapted for high voltage lines.

The fuse consists of a glass tube with outwardly flanged ends, a fibre cap at each end being fastened to fibre collars which are held in position by the flanges on the glass. The glass tube is filled with transformer oil to just above the upper extremity of the fuse wire, which is connected with each cap by a brass rod. Rubber washers and discs prevent the oil from leaking; when the fuse blows this oil immediately fills the gap caused by the broken fuse wire and forms an effective insulation which will preven arcing on the highest of voltages.

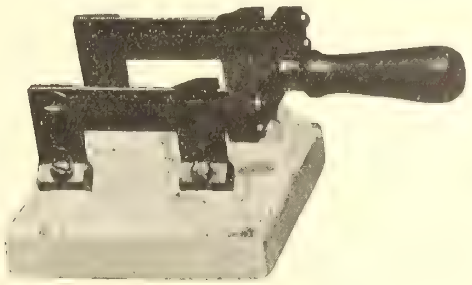
In order to make a thorough test of its current capacity, the company in one of the tests used a piece of No. 10 copper wire in place of the ordinary fuse wire and short circuited the fuse o 2200 volts with very good results.

The Hill Electric Switch Company, of 426 St. Paul street, Montreal, have the sole right to manufacture the new fuse for the Canadian market.

Mr. Edward Ryan, of Milltown, N.B., is the inventor of a wave motor which was described in the ELECTRICAL NEWS some time ago. t is reported that New York capitalists have an option on the invention conditional upon its proving practicable for commercial purposes. It has been patented in Canada, the United States and Great Britain.

Our Latest 25 Amp. D.P. Porcelain Base

The Cheapest and Best



All Particulars for the Asking

The HILL ELECTRIC SWITCH CO., Limited

426 ST. PAUL STREET, MONTREAL

TRADE NOTES.

The Robb Engineering Company, of Amherst, N. S., have lately introduced a new type of engine known as the "Robb Armstrong Corliss," the construction of the valves being on the original Corliss plan with a very ingenious valve gear invented by Mr. E.J. Armstrong. The company have now twenty-five of these engines under construction, five of them being for the shops of the Canadian Pacific Railway at Montreal and two for the same company at Fort William.

The Dodge Manufacturing Company have received a letter from Mr. Kenneth L. Warren, manager of the River du Loup Pulp Company, Limited, Frazerville Que., in which he says: "The rope on our rope drive requires taking up, and we thought we would like to have it attended to during the dull season, owing to low water. We feel that a splice made by your expert will be more satisfactory and less expensive in the long run. Are any of your men in this district now, or can you send us a man, preferably the man who installed the drive. In this connection we feel obliged to mention to you the complete satisfaction that we feel with the rope transmission installed by yourselves for us about a year ago. It has worked smoothly and quietly, and with absolutely no attention whatever, excepting that the bearings are oiled occasionally, and the tension carriage rope taken up once in a while. To our minds the drive is perfect, and we are very much pleased with the installation."

SPARKS.

The British Columbia Electric Railway Company purpose building an addition to their car shops at New Westminster.

Mr. F. H. Dickenson, of Hamilton, has been awarded the contract for fencing the right of way for the transmission line of the Toronto & Niagara Power Company between Niagara Falls and Toronto. The work will be commenced as soon as spring opens.

The Electric & Train Lighting Syndicate, Limited, has recently been organized in Montreal, with a capital of $150,000, the promoters being Messrs. R. A. Ross. E. E., W. G. Throsby and W. C. J. King, of that city, and J. H. Plummer and Frank Plummer, of Toronto.

Hon. John Sharples, Hon. N. Garneau, and others, of the city of Quebec, are forming a company to connect parishes of St. Colombe de Sillery, Bergerville, and Charlesbourg, with the city of Quebec by means of an electric railway. It is proposed to carry freight as well as passengers, and if the application for incorporation is granted work on the road will be started immediately.

An Ontario charter has been granted to the Canadian Steam Boiler Equipment Company, Limited, to manufacture and deal in steam boilers, boiler equipments, plumbing materials, etc. The head office of the company is in Toronto, and the promoters incude Mr. P.E. Durst, manufacturer, of Toronto, and M. E. Shantz, manufacturer, of Berlin.

NEW TELEPHONE LINE

A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates:

Port Rowan - - 50c.
St. Williams - - 50c.
Vittoria - - 40c.

THE BELL TELEPHONE CO. OF CANADA

We are the Originators of the System of

CENTRAL STATION HEATING

In Large Cities

Electric Companies By installing our underground system of steam heating can pay their entire station expenses and interest on the steam investment

More than 250 such plants in successful operation.
Cheap coal takes the place of the consumers, expensive anthracite.
We contract for the construction of the steam mains complete.
Our work is the best. We have the only METER SYSTEM in use.
Our expansion devices and our installation are the most effective.

WE ALSO MANUFACTURE
Wooden Water Pipe, Steam Pipe Casing, Steam Traps, Valves, Condensation Meters, Economizing Coils, Separators, and a full line of STEAM FITTERS' SUPPLIES.

Write for Pamphlet and Price List

AMERICAN DISTRICT STEAM CO.
LOCKPORT, N.Y.

SPARKS.

The annual dinner of the American Institute of Electrical Engineers will be held at the Waldorf-Astoria, New York, on February 11th, at 7 p.m.

Electrician Carruthers, of Acton, Ont., is about to submit to the town council an estimate of the cost of installing a plant for the supply of electric light and power.

The contract for lighting the town of Sydney Mines, N.S., has been awarded to W. A. MacKay & Company, of Sydney. The town takes 100 lights and there will be about 2000 house lights. The contract figures are $17 a year for 32 candle power light for street purposes and 11 cents per killowatt hour for private residence. The plant is to be installed by July next.

The Metropolitan Power Company, of Ottawa, have decided to carry to completion their proposed works at Britannia, and to that end have engaged Mr. John Kennedy, consulting engineer, of Montreal, to supervise the construction of canal and power house. The plans call for the development of 6,000 horse power, and it is the intention to have the work completed this year.

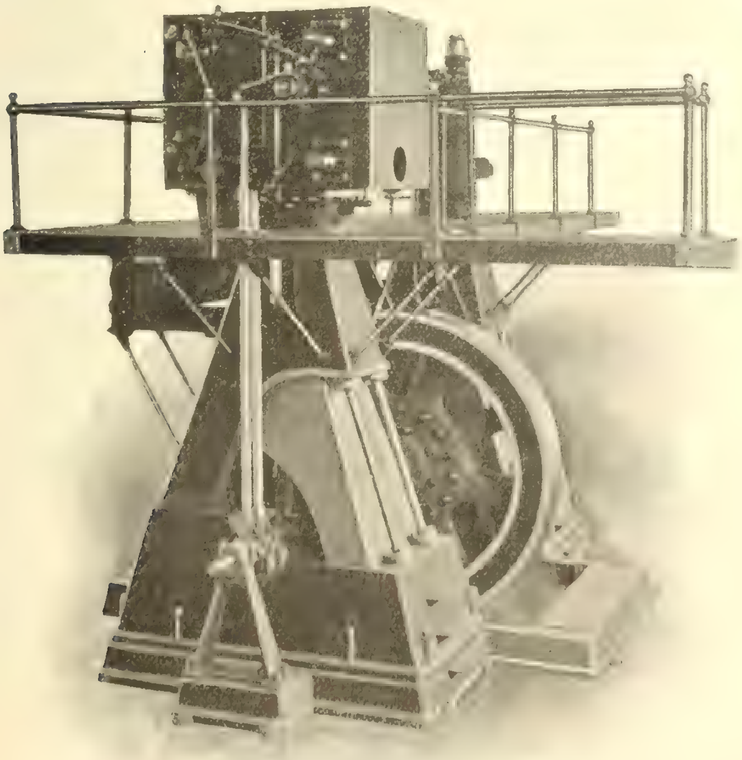
Mr. M. Hutchison, superintendent of the Lighting Department of the city of Victoria, B.C., has submitted his annual report for 1903, in which he recommends that the boiler settings be renewed and that the Ball dynamos operating on district No. 5 be replaced by a modern machine of increased capacity and suitable to operate enclosed lamps, and further, that the above mentioned district be equipped with lamps of latest type. If the new dynamo is installed the city will dispose of three 40-light and one 35-light Ball dynamos. The total number of lamps in service is 292, of which 178 are of modern type, 2,000 candle power, the balance being of 1,600 candle power of an out of date type. The total dynamo capacity is 340 lights. Mr. Hutchison recommends the adoption of the enclosed long burning lamp, the chief advantages of which are that the light is steady and free from glare and one trimming lasts about 100 hours, so that the cost of attendance and carbons is decreased.

MOONLIGHT SCHEDULE FOR MARCH.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Mar. 1	No Light	Mar. 1	No Light	
2	6 20	2	8 30	2 10
3	6 20	3	9 30	3 10
4	6 20	4	10 45	4 25
5	6 20	5	11 50	5 30
6	6 20	7	0 50	6 30
7	6 20	8	1 50	7 30
8	6 20	9	2 50	8 30
9	6 20	10	3 40	9 20
10	6 30	11	4 30	10 00
11	6 30	12	5 00	10 30
12	6 30	13	5 30	11 00
13	6 30	14	5 30	11 00
14	6 30	15	5 30	11 00
15	6 30	16	5 30	11 00
16	6 30	17	5 30	11 00
17	6 40	18	5 30	10 50
18	6 40	19	5 30	10 50
19	6 40	20	5 30	10 50
20	6 40	21	5 30	10 50
21	6 40	22	5 30	10 50
22	10 00	23	5 15	7 15
23	11 00	24	5 15	6 15
25	0 00	25	5 15	5 15
26	0 45	26	5 15	4 30
27	1 40	27	5 15	3 35
28	2 20	28	5 15	2 55
29	3 00	29	5 00	2 00
30	No Light	30	No Light	
31	"	31	"	
		Total		208 30

THE LAURIE ENGINE COMPANY

MONTREAL, CANADA



Some Laurie Corliss Installations:

British Columbia Electric Ry. Co. - 2,100 H. P.

Winnipeg Electric Street Ry. Co. - - 2,200 H. P.

Toronto Electric Street Ry. Co. - - 1,500 H. P.

Montreal Street Railway Co. - - 11,500 H. P.

Dominion Iron & Steel Co. - - 2,400 H. P.

Cape Breton Electric Tramway Co. - 1,200 H. P.

LAURIE CORLISS ENGINES

UNAPPROACHED FOR ECONOMY, EFFICIENCY OR REGULATION

PERSONAL.

Mr. W. T. Rutherford, chief operator for the Canadian Pacific Telegraphs at Winnipeg, has recently passed through a somewhat severe illness.

The sympathy of many friends is being extended to Mr. Chas. E. A. Carr, manager of the London Street Railway, who a few days ago was bereaved of his daughter.

Mr. George B. Lowe, Superintendent of Cape Breton Electric Railway Company, Sydney, N. S., has tendered his resignation and has been suceeded by Mr. William Luxon, recently of Bay City, Mich.

Mr. C. E. Brown, who resigned the position of asstistant engineer of the Canadian General Electric Company at Peterborough, to accept an appointment on the Government Commission which goes to Europe to investigate the process of electric smelting, was awaited upon by the employees of the company and presented with an address and a beautiful dressing case. His appointment on the commission is exceedingly popular.

A telephone line is being constructed from Edmonton to Athabasca Landing, N.W.T.

Incorporation of a company to build an electric line from Brantford to Hamilton will be sought from the Dominion Parliament, with authority to convey electrical power over the right of way, and to sell and distribute the same within the municipalities traversed by the line.

It is understood that a project is on foot to form a merger for the control of the Chaudiere water power at Ottawa. The proposal is to form a company out of the present water lot holders and to distribute power to each of them in proportion to their holdings in the joint concern. The companies likely to unite are the Ottawa Electric Company, Ottawa Electric Railway Company, Ottawa Investment Company, the Bronson Company, Ottawa & Hull Power Company, J. R. Booth and E. B. Eddy. As a preliminary to carrying out the scheme the services of Messrs. John Kennedy and William Kennedy, hydraulic experts, Montreal, have been retained. They will prepare a comprehensive report on the subject of the division and development of powers and also make suggestions as to the manner in which the power which now goes to waste over the Chaudiere Falls can be utilized.

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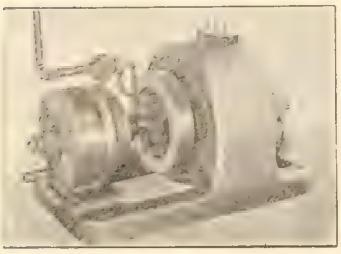

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Mr. John Wilson, Magnetawan, Ont., in renewing his subscription to the ELECTRICAL NEWS writes: "I do not like to be without it. I greatly prize its valuable contents."

SPARKS.

The Oshawa Electric Light Company are rebuilding their lines and have installed a multiple system of C.G.E. enclosed arcs on the streets.

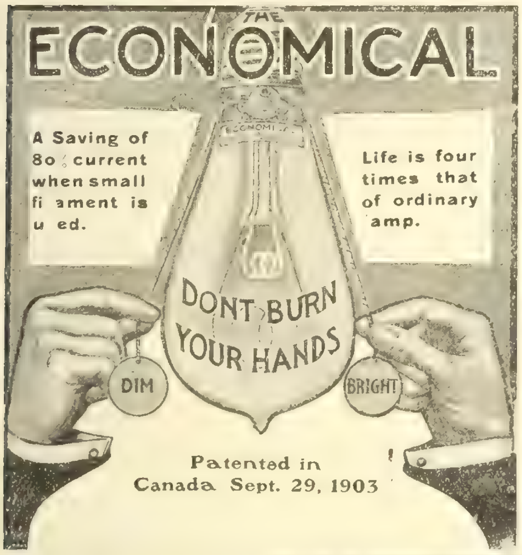
Two years ago an electric plant was installed by the village of Glace Bay, N.S., and a report recently published shows that it was operated at a slight profit in 1903.

A special committee has requested the City Council of Montreal to apply to the Legislature to borrow $1,200,000 for the construction of a conduit system of underground wires in that city.

The Whitby, Ont., Council, on behalf of the town, have bought the private electric light plant, and are at present engaged in building a combination pumping and power plant near Lake Ontario and 1½ miles from the town proper. The laying of the 6 inch water main from the plant to town is nearly completed.

Incorporation has been granted to the Petewawa Power Company, Limited, with head office in Toronto and a share capital of $250,000. It is proposed to develop water powers in the vicinity of Pembroke. The directors include Messrs. Duncan Donald, M. P. Vander Voort, C. H. McArthur, T. B. Robertson and William Lawson, all of Toronto.

The Charlotte Telephone Company, Limited, of Charlotte, N.B., has been incorporated, with a capital stock of $7,500, for the purpose of establishing a telephone system in Charlotte County. The promoters are Messrs. A. Ganong, F. W. Andrews, Lewis F. Mills, A. D. Ganong and W. M. Mills, all of St. Stephen.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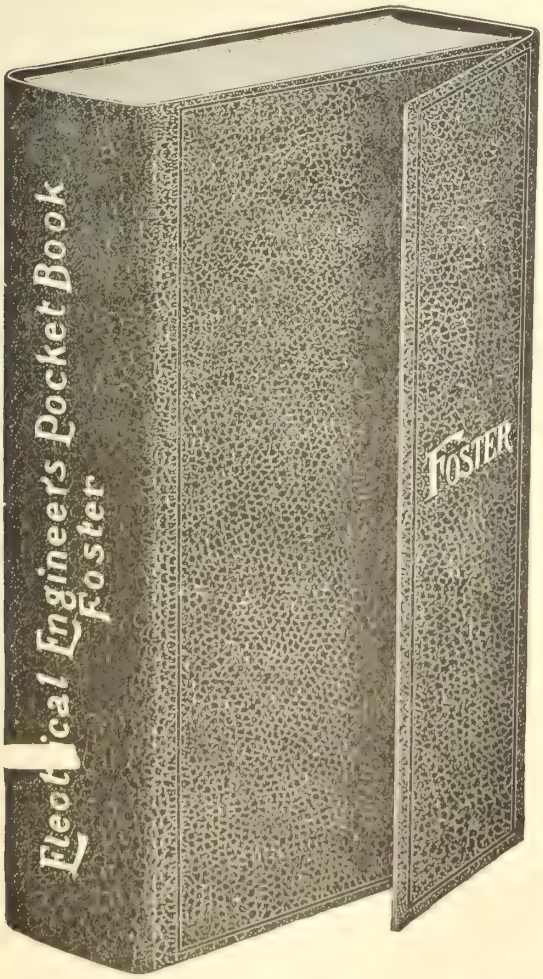

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Anyone making a pretense to Electrical Engineering, needs this book, 'tisn't a matter of "how much" or "how little" the cost may be, it's a matter of how quick they can get a copy in their possession, it is a real necessity and for their own daily good.

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An index to the contents means too much space here. An index will be sent on request.

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SPARKS.

The Shawinigan Electric Company, of Shawinigan Falls, Que., have applied for a charter of incorporation.

The old electric light plant which furnished light to the Parliament Buildings at Ottawa was recently sold to Thomas Lawson, of that city, for $1,295.

The city of Windsor, Ont., has applied for legislation to place the lighting system under the management of a commission of three persons to be selected by the people.

Several manufacturers in the vicinity held a meeting at Almonte, Ont., recently to discuss the question of securing a better and more uniform water supply for power purposes by the mill owners along the Mississippi river. Messrs. T. B. Caldwell, of Lanark, B. Rosamond, of Almonte, and others were appointed a committee to form a company to undertake the necessary work. It is proposed to construct three concrete dams so as to store up water in the spring to keep the river up to a working level.

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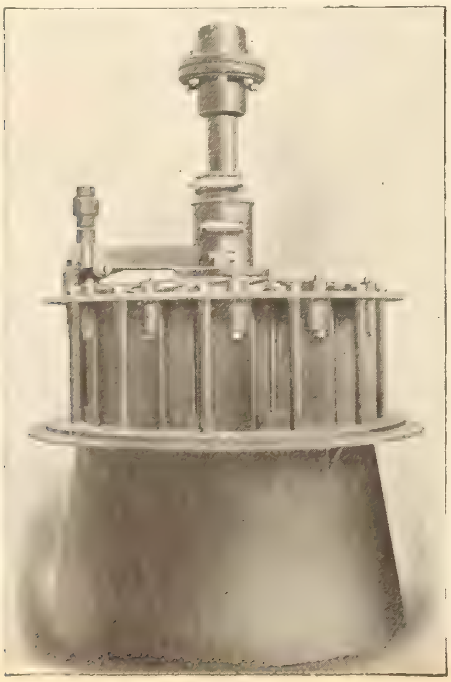
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SPARKS.

The city of Brandon, Man., wants an engineer to superintend the waterworks, sewers, and other public works.

A company headed by Dr. Ickes, of Brantford, Ont., is seeking incorporation to build a radial railway between Brantford and Hamilton, running through Ancaster township.

The Hamilton, Grimsby & Beamsville Electric Railway Company have submitted to the City Council of St. Catharines, Ont., a proposition to extend their electric road from that city to Vineland, a distance of about eight miles. The extension would necessitate the construction of several bridges, one across the old Welland canal.

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SPARKS.

The Montreal Corporation Trust Company have made a proposition to furnish electric power to the town of Meaford, Ont.

Mr. R. A. Ross, E. E., of Montreal, has been engaged by the town of Preston, Ont., to estimate the value of the two electric light plants there, as well as the cost of a new plant.

The telephone franchise of the city of London, Ont., has expired, and the Bell Telephone Company and the Canadian Telegraph & Telephone Company have submitted offers for a new franchise.

Canada's pavilion at the World's Fair is finished. The structure is one of the most ornate among the many attractive of foreign buildings and occupies an advantageous site north of the Palace of Agriculture. The intra-mural railway passes the main entrance.

At the annual meeting of the shareholders of the Hamilton, Grimsby & Beansville Electric Railway, held recently, the statement presented showed that the business of the company is 1903 was greater than in any previous year. The directors have elected the following officers: President, C. J. Myles; vice-president, W. J. Harris; secretary and manager, George Waller.

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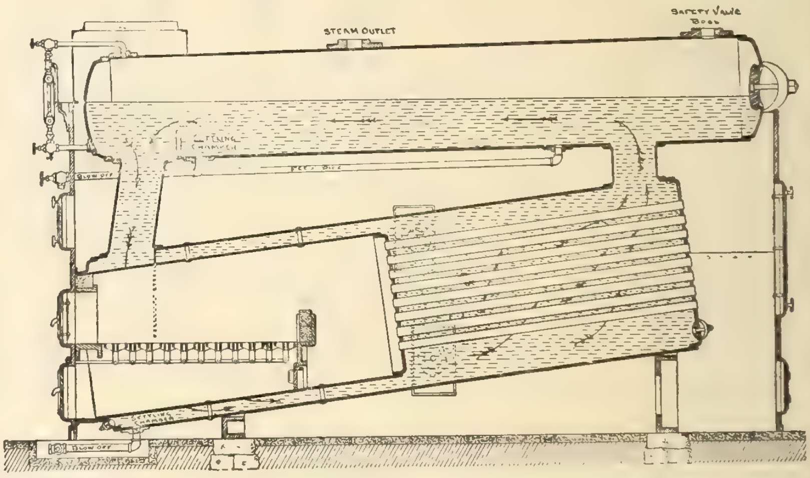

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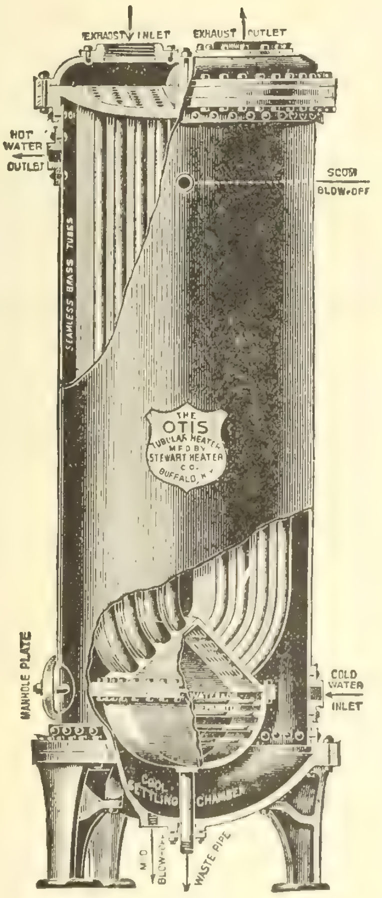

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SPARKS.

The Sandwich, Windsor & Amherstburg Railway Company has issued a writ against the town of Amherstburg for $10,000, which sum was promised by the town when the line was extended to Amherstburg, but which has not yet been paid.

Messrs. Cassels, Cassels & Brock, soliditors, of Toronto, have applied for the incorporation of a company for the purpose of acquiring land in the town of Port Arthur, Ont., and for developing electric power, with the right to sell or lease the said power to the towns of Port Arthur and Fort William.

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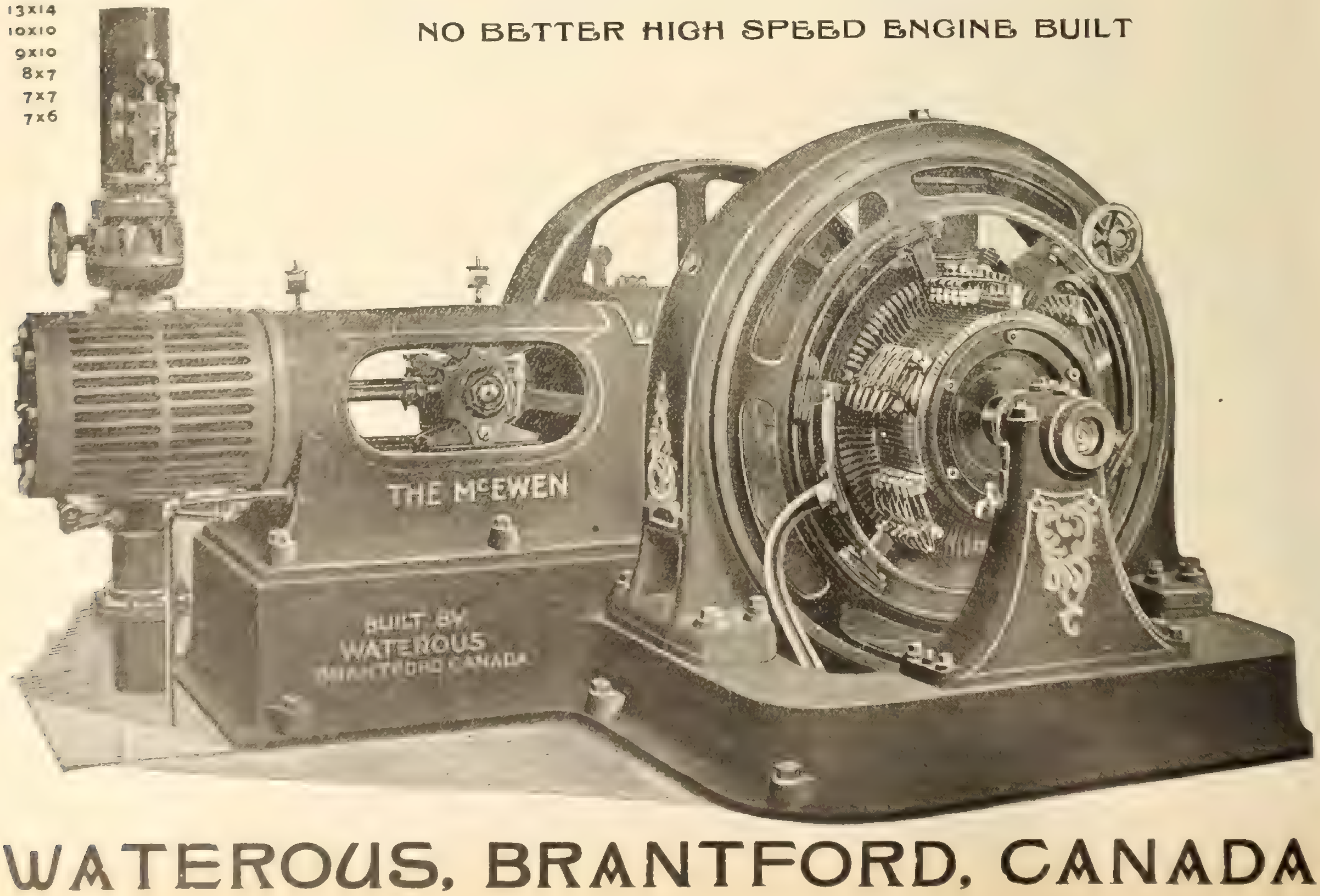

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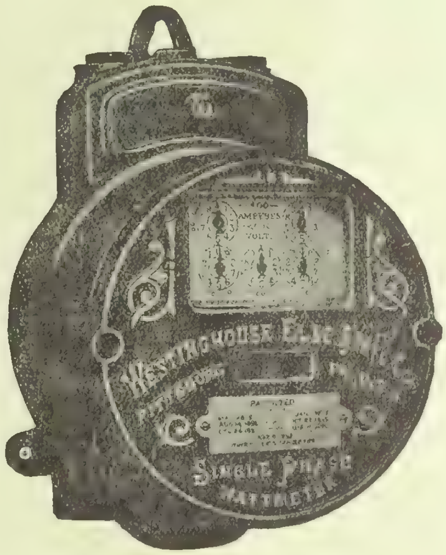

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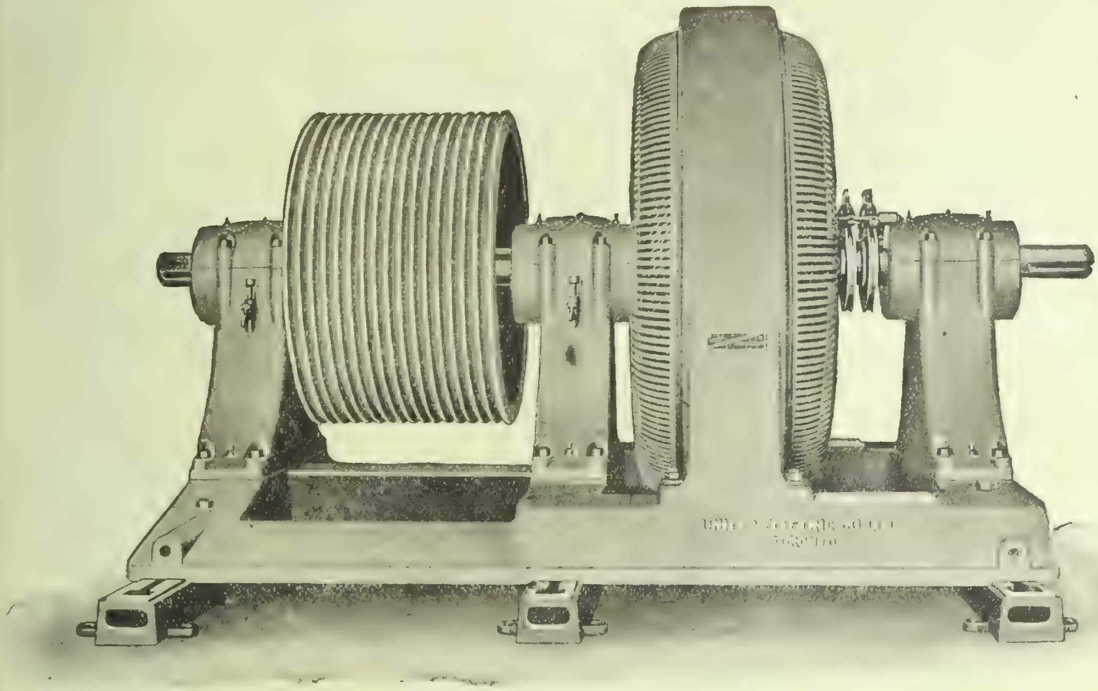

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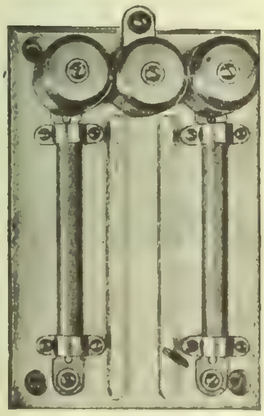

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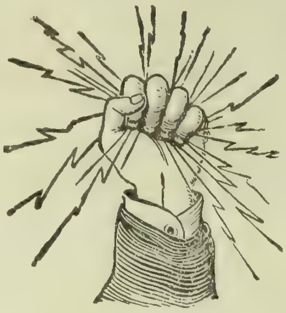

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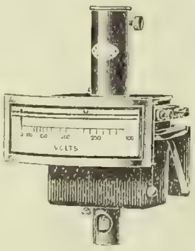

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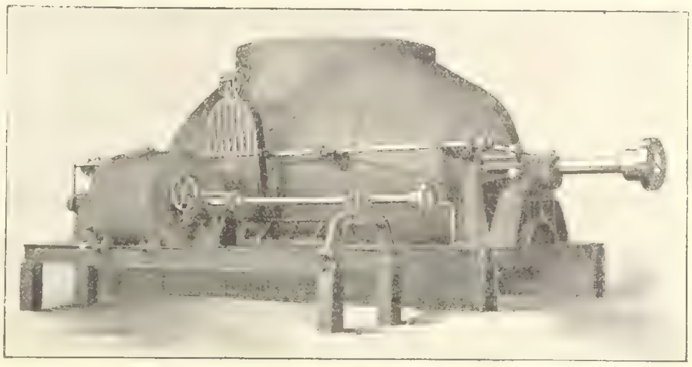

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SPARKS.

The Council of North Toronto, Ont., are considering the question of remodelling the electric light plant.

The central office of the New Brunswick Telephone Company at St. Stephen, N. B., was slightly damaged by fire on February 24th.

Mr. W. Smith, manager of the New Brunswick Telephone Company, at Fredericton, N. B. has recently been ill with typhoid fever.

Mr. Lewis Boyer, solicitor, of Montreal, has made application for incorporation of the Canadian Traction & Power Company, to construct an electric railway from Montreal to Ottawa.

It is reported that the British Columbia Electric Railway Company, of Vancouver, B. C., have decided to postpone for the present the work of enlarging their power plant at Goldstream.

The Spruce Creek Power Company, Limited, has been incorporated under the laws of British Columbia, to develop water powers for the purpose of furnishing electric light, heat and power.

The Cedar Rapids Manufacturing and Power Company have asked for a Dominion charter giving them power to develop and operate water powers on the River St. Lawrence, in the County of Soulanges, Quebec.

The Jordan Light, Heat & Power Company is applying to Parliament for authority to amalgamate with the Erie and Ontario Development Company under the name of the latter company. Mr. D'Arcy Scott, of Welland, is solicitor for the applicants.

The Charlotte County Telephone Company, Limited, has been incorporated to construct and operate a telephone system in the County of Charlotte, N. B. The incorporators include Messrs. Frank W. Andrews, J. E. Ganong and Lewis S. Mills, of St. Stephen.

The Pittsburg Transformer Company, in commenting upon their fiscal year just closed, state that it showed an increase of 42 per cent. over the business of the preceeding year. They claim that this fact is the strongest argument they can bring forth showing the steadily increasing popularity of their product. Another interesting fact shown by the records is that only two transformers in their entire output for 1903 were burned out from any cause whatever. When it is considered how important durability and thorough insulation are in a transformer, this also speaks well for the Pittsburg Transformer Company's product.

MOONLIGHT SCHEDULE FOR APRIL.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Apr. 1	7 00	Apr. 1	9 30	2 30
2	7 00	2	10 40	3 40
3	7 00	3	11 40	4 40
4	7 00	5	0 40	5 40
5	7 00	6	1 30	6 30
6	7 00	7	2 20	7 20
7	7 00	8	3 00	8 00
8	7 00	9	3 45	8 45
9	7 00	10	4 15	9 15
10	7 00	11	4 45	9 45
11	7 00	12	4 45	9 45
12	7 00	13	4 45	9 45
13	7 10	14	4 45	9 35
14	7 10	15	4 45	9 35
15	7 10	16	4 30	9 20
16	7 10	17	4 30	9 20
17	7 10	18	4 30	9 20
18	7 10	19	4 30	9 20
19	7 15	20	4 30	9 15
20	7 15	21	4 30	9 15
21	10 45	22	4 30	5 45
22	11 30	23	4 30	5 00
24	0 15	24	4 15	4 00
25	1 00	25	4 15	3 15
26	1 40	26	4 15	2 35
27	2 15	27	4 15	2 00
28	No Light	28	No Light	
29	"	29	"	
30	7 30	30	9 30	2 00
		Total............		185 10

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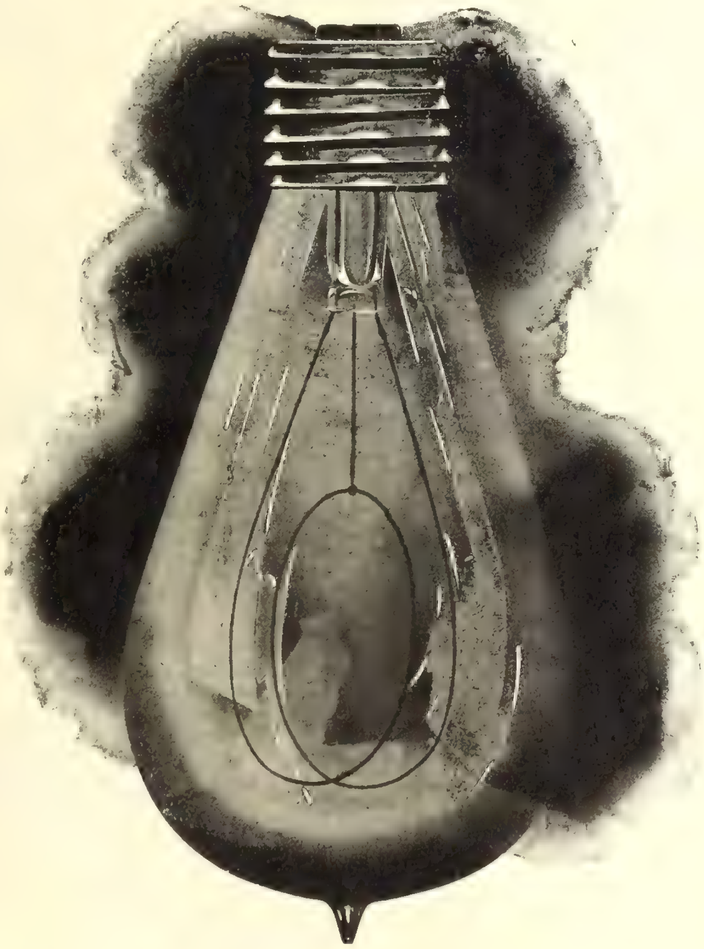

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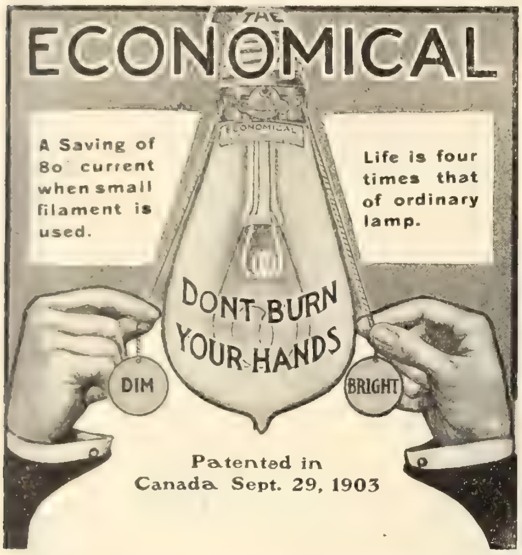
The Pittsburgh Transformer Company announces the fact that during the past year they have been adding to their facilities to enable them to handle to better advantage their line of large transformers for power transmission. These transformers are supplied in sizes from 50 to 250 k. w. and in voltages from 100 up to 15,000 volts. Illustrations of these transformers will be sent to any parties interested in power transmission. In describing these it may be said that the transformers are of the shell type construction, containing, however, some new features in the way of ventilation spaces between the various coils of the windings. Transformers are self-cooling, oil-insulated, and are mounted in fluted sheet steel tanks. The construction of the tanks themselves appears to be exceedingly simple and of unusually good mechanical design. The sheet steel tanks are mounted on a cast iron base and have a cast iron top with a 12-inch hand-hole, enabling easy and thorough inspection of the interior. From the illustrations showing these, it is easily seen that these transformers embody the latest ideas in this class of construction, and it is easy to understand the significance of the company's statement that they have never yet lost by burn-out, from any cause whatever, a single one of these power transformers, although many thousand kilowatts are in daily operation.

SPARKS.

The Minnedosa Electric Light & Power Company, of Minnedosa, Man., have about completed a new power house.

The ratepayers of Waterloo, Ont., recently carried a by-law to bonus the Waterloo & Wellesley Electric Railway to the extent of $4,000.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We want to say right now that hereafter we shall solicit your business direct. We want you to send your orders straight to us at Pittsburgh.

Your orders will be shipped from Pittsburgh the day we receive them. And in passing let us state that in spite of our stock in Montreal, over eighty per cent. of our Canadian orders have been shipped direct from here.

The two important things about this, our new policy, are firstly, elimination of the delays and mistakes which seem to be ingrained in the agency plan ; and secondly, a price which is only possible by direct factory dealing.

We want your transformer orders, whether for a single transformer or for a dozen.

Pittsburgh Transformer Company,

Pittsburgh, Pa.

SPARKS.

An electric light plant is being installed at Weyburn, Assiniboia.

The Ste. Claire Electric Company, of Ste. Claire, Que., has been organized and granted a charter.

The Terrebonne Electric Railway Company, of Terrebonne, Quebec, has been granted a charter of incorporation.

The Cascade Power Company, Limited, has been incorporated by the British Columbia Government, with a capital of $50,000.

Messrs. W. J. O'Leary, & Co., electrical contractors, of Montreal, will probably install an electric light plant at Rexton, N. B.

Mr. Wm. Eager is formulating a scheme to furnish electric power to the villages of Morrisburg, Winchester and Chesterville. The idea is to enlarge the plant at Morrisburg.

The Ste. Claire Electric Company, of St. Anselme, Que., is considering the question of constructing an electric railway through the counties of Dorchester, Bellechase and Levi.

Mr. C. H. Rust, City Engineer of Toronto, has reported that an electric plant for lighting the Island and for furnishing power and light to the residents would cost $90,000. This would give 250 arc lights and 2,000 incandescent lights.

The new Engineering Department at Mount Allison University, Sackville, N. B., is opening up favorably. About twenty students are taking the course. A five h. p. motor, a $300 circular saw, and ten wood and metal working lathes have been installed.

Mr. James McDougall, C.E., has made the final survey for the power dam and tunnel to be constructed in Erindale, Peel County, by Mr. Joseph Barrett, of Toronto. The power to be developed is on the Etobicoke river. It is proposed to transmit to Toronto, the estimated expenditure for the work being $150,000.

The Bell Telephone Company are about to undertake extensive improvements in the city of Winnipeg. A new building will be erected on Thistle street which will contain a switch-board with accommodation for over 10,000 subscribers. Extensive underground work in the vicinity of the C. P. R. subway on Main street will also be undertaken.

The city of Tacoma, Washington, secures electric power at a very low rate. The Tacora Cataract Company accepted a five years' contract at .84 cent per kilowatt hour. This rate was obtained by reason of competition between two companies. The rate previous to the present agreement was 1.62 cent per kilowatt hour.

The Canadian Pacific Railway Company are looking into the advisability of consolidating their electric plants in Vancouver, B. C. At present the central depot, the Vancouver hotel and opera house and the shops and local yards are each lighted by separate plants driven by steam power. It is probable that arrangements will be made to obtain current from the Vancouver Power Company.

The C. P. R. Telegraph Company purpose extending their lines this summer until they will have in operation about 66,000 miles of wire. An additional wire will be strung from Toronto to Peterboro and one from Toronto to Windsor. Another copper wire will be placed between Montreal and Winnipeg, which will be used as a third duplex between these points, and an additional copper wire will be strung between Montreal and Quebec.

The syndicate represented by E. W. Backus, of Minneapolis, has finally concluded an agreement with the Ontario Government for the development of the water power on the Rainy River at Fort Francis, Ont. The agreement provides that the syndicate shall develop the water power to its full capacity and shall render permanently available on the Canadian side one half of the power. The development is to be completed by May 1, 1906, and within nine months of the date of the agreement $50,000 is to be expended. It is estimated that 16,000 horse power can be developed.

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ANNOUNCEMENT

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As some of our competitors have circulated the report that an injunction had been obtained restraining the manufacturers of the Gutmann Meter from making these celebrated instruments here, we would say that such is not the case. We have a large stock on hand and a large shipment on the way from our Canadian Factory and can ship all orders immediately upon receipt.

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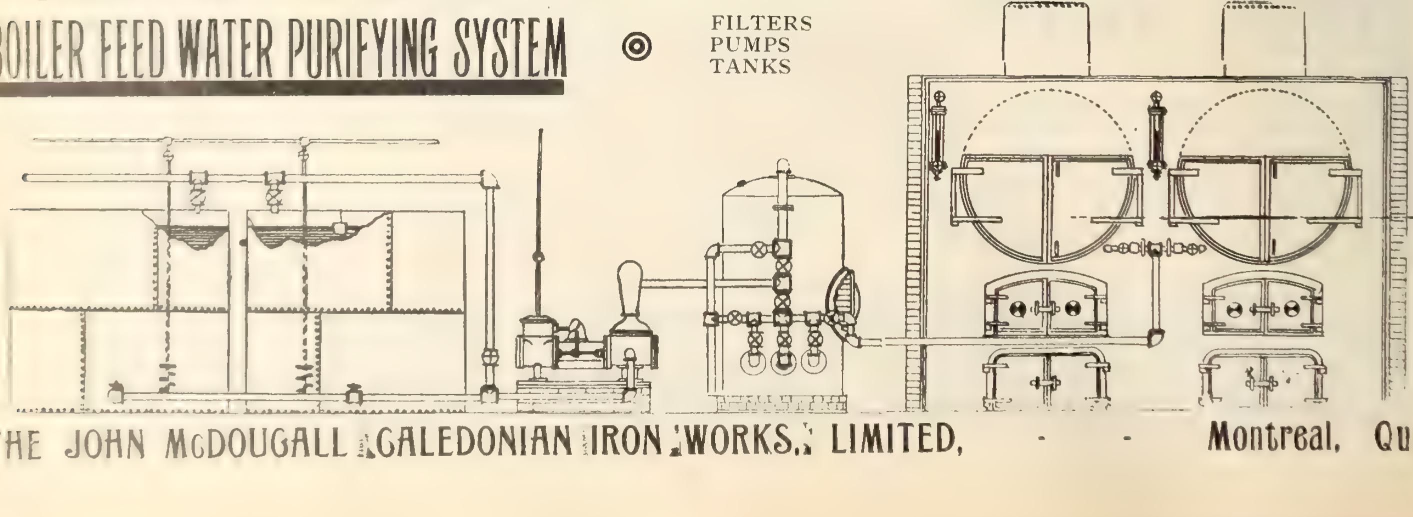

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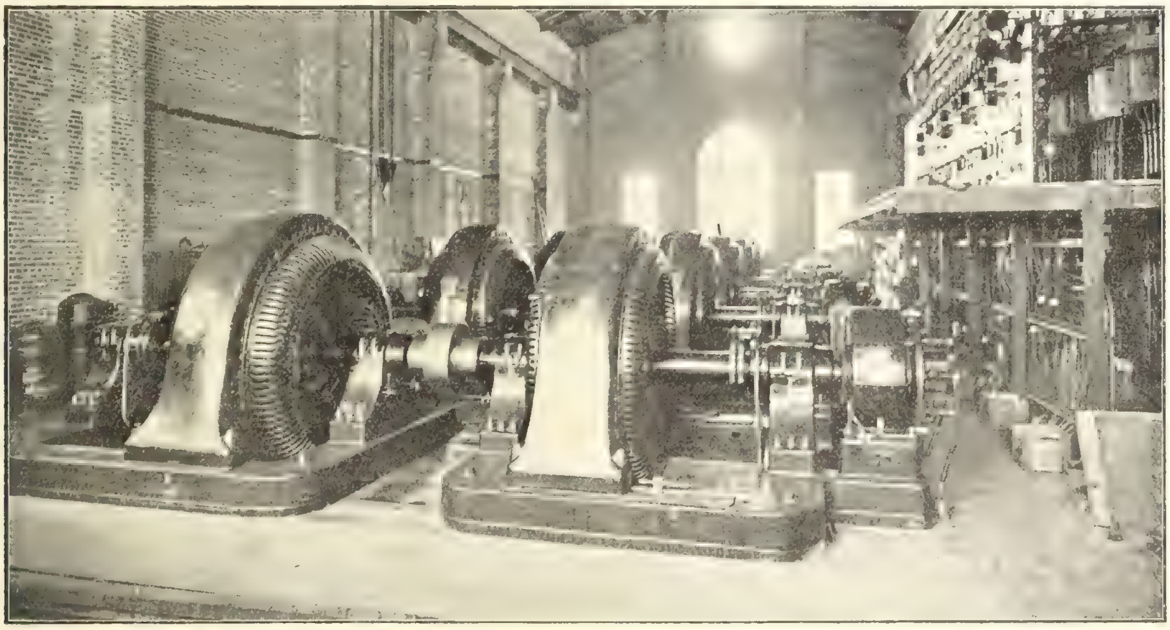
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIV. MARCH, 1904 No. 3.

SUB-STATION OF THE SHAWINIGAN WATER & POWER COMPANY.

The accompanying illustration shows the interior of the Montreal sub-station of the Shawinigan Water & Power Company, which is entirely equipped with Bullock frequency changers. It will be noticed that there are five sets of frequency changers, each set consisting of a 1,500 h. p., 30 cycle, synchronous motor, direct coupled to a 1,000 k. w., 60 cycle generator. These machines operate at the end of the 90 mile transmission line from Shawinigan Falls to Montreal and transform all the 30 cycle power received to 60 cycle current for use in the City of Montreal. These sets operate together in parallel on both the 30 cycle and the 60 cycle ends, and so successful is their operation that no cross currents whatever are indicated between the machines.



BULLOCK FREQUENCY CHANGERS IN SUB-STATION OF SHAWINIGAN WATER & POWER COMPANY, MONTREAL.

ELECTRICAL INSTALLATIONS IN WINNIPEG.

The annual report of Mr. F. H. Cambridge, city electrician of Winnipeg, Man., states that the unprecedented activity in building during 1903 resulted in a great increase in the number of electrical installations, the comparison with the previous year being as follows:

Permits issued 1902, 509.
Permits issued 1903, 1,102.
Incandescent lights wired for 1902, 8,860.
Incandescent lights wired for 1903, 14,194.
Arc lights installed (interior) 1902, 45.
Arc lights installed (interior) 1903, 66.
Horse power in motors installed 1902, 259.
Horse power in motors installed 1903, 654.

Mr. Cambridge recommends re-inspection in the business district, as he states that it is frequently found that the safety of what was a first-class installation is destroyed through the actions of caretakers and other persons who undertake to make repairs and install additional lights.

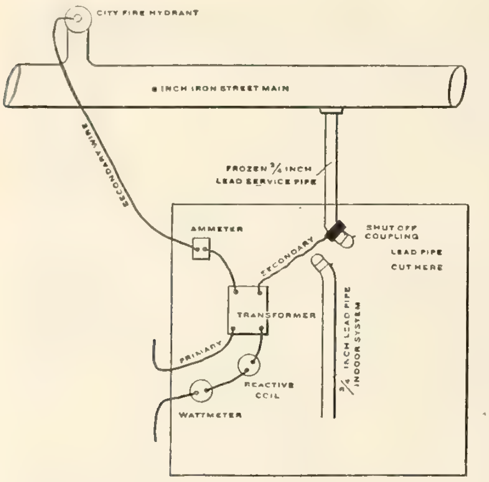
The street lighting system was materially extended during the year. The original circuits, four in number, were overloaded and were sub-divided into six. The change in the system of current supply for the new lamps necessitated the wiring of two independent circuits for the new alternating current system. The above changes and the wiring for the additional 50 lamps authorized last year have brought the mileage of wire used by the city from 70 miles to 98 miles. The present eight circuits have now a capacity for 400 lamps, so that additional lamps up to that number can be connected at comparatively low line cost.

There are in use in the town of Orillia, Ont., 5,313 electric lights. As the result of a recent investigation, the Light Department found many cases where householders were using a greater number of lamps than they were paying for.

THAWING OF WATER PIPES BY ELECTRICITY.

The extremely cold weather this winter has resulted in many frozen water pipes, for the thawing of which electricity has been employed to a greater extent than ever before. The Ottawa Electric Company were probably the first in Canada to adopt electricity for this purpose. In the winter of 1898-99 they conducted experiments, particulars of which were published in the Electrical News, but which are again reproduced for the benefit of those desiring information on the subject. A diagram showing the arrangement of the electrical apparatus is also given.

Mr. John Murphy, superintendent of power house, and Mr. W.G. Bradley, superintendent of construction for the Ottawa Electric Company, along with a representative of the City Engineer, conducted the experiments in Ottawa. Two Packard transformers, type F, made for 1,000 and 2,000 volts on the primaries, ratio of transformation of one to twenty, 125 cycles, were mounted on a sleigh and driven around where required. It was usually drawn up to the foot of the pole and primary wires carrying about 1,000 volts were brought down to the transformers by means of flexible wires. The transformers were worked in parallel and had the connections so made as to obtain a ratio of transformation of forty to one so that about 25 volts were obtained on the secondary. With this arrangement it was found possible to do without the reactive coil and other means of regulation which had been used in the first trials, so that the pipe-thawing outfit consisted simply of the two transformers above referred to and an ampere meter which was inserted on the primary, there being no portable instrument with large enough range to put on the secondary; a voltmeter was connected across the secondary coils.



Method of Thawing Water Pipes.

Following is the data of five trails which were made.

1st. Secondary volts 17, primary amperes 8. Connections made from water pipe 25 feet of ⅝″ lead pipe to a hydrant at the door. Water flowed in three minutes and came out at full pressure in six minutes.

2nd. Secondary volts 21, primary amperes 5. Connections from water pipe in one house through about 100 feet ⅝″ lead pipe and 16 feet 5″ iron pipe to water tap in next house. One of the services only was frozen. Water flowed in eight minutes and with full pressure in ten minutes.

3rd. Secondary volts 22, primary amperes 9. Connections made to water tap inside and to iron main pipe in the street, which was reached by opening a manhole. Current passed through 25 feet ⅝″ lead and 4 feet of 5″ iron main. Water flowed freely in two minutes.

4th. Secondary volts 23, primary amperes 7. Connections made from water tap in one house through about 60 feet ⅝″ lead and 24 feet of 5″ iron pipe to the water taps in the next house. Water flowed in one minute and the full pressure was on in three minutes.

5th. A lead pipe service between a residence and a stable being frozen, connection was made between the water taps in each place and water flowed freely in one minute. No reading of current was taken in this last case.

By the time the pipes completely thawed out the water in some parts of them had become very hot. In some cases it was found impossible to get any water through at all. This was due to the style of joints made in some of the main iron pipes where there was no electrical contact between the different lengths.

An experiment at Chatham, which was also entirely successful, was conducted by Mr. Jones, Superintendent of Waterworks, by the aid of current and a transformer of 100 amperes capacity supplied by the Gas and Electric Company. Using a current of 25 volts, two frozen hydrants were thawed in 45 minutes.

Concerning the work done this winter by the Ottawa Electric Company, the superintendent, Mr. A. A. Dion, writes as follows :

"This year the cold has been so severe that the city has not been able to cope with the trouble of frozen pipes with the ordinary means at hand, such as steam boilers mounted on sleighs, etc. If the freezing has extended into the street they can do little and that only at great expense. The City Engineer having asked for our assistance, we rigged one of the company's express sleighs for the purpose ; four transformers of 5,000 watts each were put in this sleigh and connected two in series on their primary side. The secondary connections were such that when the transformers were attached to the line wires by means of small flexible rubber covered cables, each transformer got half the primary voltage for which it was made, and the secondary voltage was about 25 volts. The normal current capacity of the secondaries as connected was 400 amperes. We also had a rheostat in series with the primary cables and an ammeter. A board about 6 feet long was set upright in the sleigh, on this a shelf was attached for the ammeter and a cross piece at the top carried two primary cut-outs, to which were attached the cables to line wires. Two coils of No. 0000 insulated cable, each about 200 feet long, were carried for secondary connections. One connection from the secondary of the transformers was made to the lead pipe inside the building where water was stopped. This connection was made by means of a brass clamp which surrounded the lead pipe without injuring it and afforded sufficient surface to pass a large current to the lead pipe without burning it. The other secondary lead was taken to the next house or to the nearest hydrant. Care was taken to connect to the lead pipe below the point where the pipe was empty, because the empty pipe would heat too much with some currents which were used. The currents varied from about 90 amperes to about 275 and the time occupied before water would flow varied from four minutes to three hours. Usually if there is any chance of success results will be seen in a very few minutes. In some cases we could not get enough current through to produce any satisfactory results. This was attributed to bad joints in the pipes causing unusual resistance. Three men went with the outfit, one driver and two linemen."

THE TORONTO TECHNICAL SCHOOL.

The growing demand for technical education is emphasized by the history of the Toronto Technical School. This School was organized in 1891 as an Evening School, with 300 students the first year. Last year the attendance was 1,840. In 1900 the School was removed from the old Wycliffe Hall to the present commodious building on College Street, opposite University Crescent, and a Day School was added to the Evening School. This Day School will enroll 400 students in this, its third year of existence.

Toronto Technical School.

The School's work embraces six departments: Chemistry, Physics, Mathematics, Commerce, Drafting and Industrial Art, and Domestic Science. Our readers are most interested in the Physics Department, a few details of which we give below:

The evening classes in the electrical and engineering courses of this department are free; a small fee is charged for the day classes. In the evening classes—in which about 200 students are registered—the work in electricity embraces a study of the construction and action of batteries, bells, telephones, telegraphs, lamps, meters, insulators, etc.; calculations as to size of wire, distance, and drop of potential, and as to the magnetic circuit; the action of direct current dynamos and motors; testing for faults in machines and lines; practical problems in testing dynamos and motors and in measuring currents, resistance, losses by friction in bearings and brushes, magnetic pull of armature and by hysteresis and eddy currents; brake horse power tests; magnetic leakage; testing for short or broken circuits; capacity of condensers, etc.

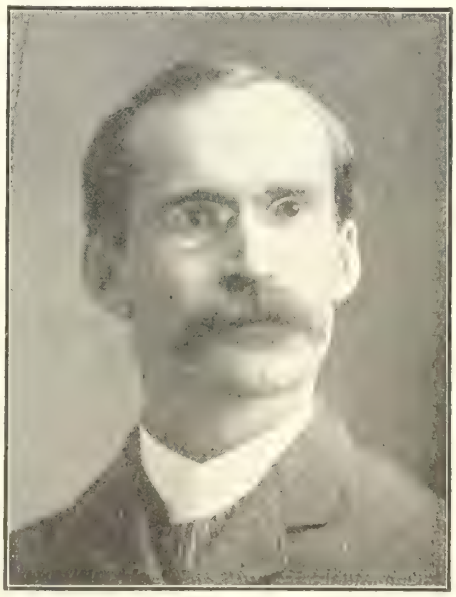
The day classes—in which about 75 are registered—pursue the same courses with greater minuteness and in conjunction with other courses in mathematics, chemistry, mechanical drawing, etc.

Belonging to the same department of physics are the Evening courses in heat, hydrostatics, the steam and gas engine, mechanics, and machine construction. About 225 are registered in one or more of these classes. The course in heat embraces conduction, convection, and radiation; heating and ventilating systems; volume, temperature and pressure in steam; specific and latent heat with practical applications. The course in hydrostatics includes the study of the laws of fluids as exemplified in machinery such as presses, syphons, pumps, compressors, brakes. In mechanics practical problems are given and tests made in measuring stresses and strains, the strength of materials, elasticity, friction, etc.

The course in the steam engine, illustrated by models and lantern slides, deals with the production of steam, the mechanism of the engine, valves and valve gears, adjustments, lap and lead, indicators and cards, reversing gears, governors, compounding, boilers and accessories, etc. While intended for all apprentices, this course is specially fitted for young engineers desirous of qualifying for certificates.

A course in machine drawing and designing, including the proportioning of parts, accompanies the above courses. Here again Day classes, in which about 90 students have been enrolled this session, repeat with greater minuteness, and accompanied by other subjects, these Evening courses.

It is quite within the mark to say that the success of the Technical School in late years is due in no small degree to the untiring efforts of the principal, Dr. Pakenham, who has the interest of the School and of technical education deeply at heart. W. Pakenham, B. A., D. Paed., was born at Glen Miller, Ont., and educated at the Peterboro Collegiate Institute and at Toronto University. He taught for several years in the Public and High schools of Ontario and was appointed principal of the Brockville Collegiate Institute in 1894. He was Registar of the Education Department and Chairman of the Board of Examiners of Ontario in 1897. He has been principal of the Toronto Technical School since January, 1902.



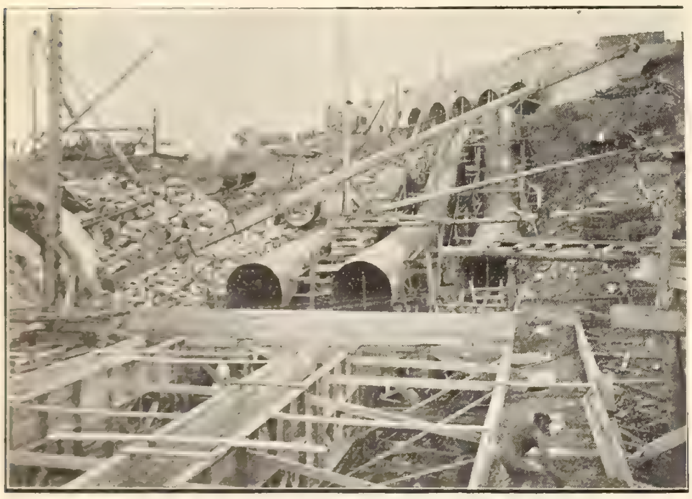
Dr. Pakenham,
Principal of the Toronto Technical School.

It is understood that John and James Kennedy, hydraulic engineers, of Montreal, who have been engaged to submit a plan to overcome the anchor ice difficulty at the Chaudiere Falls, Ottawa, will recommend that either the present dam be rebuilt or an entirely new one constructed.

ELECTRICALLY EQUIPPED PULP MILL.

The Spanish River Pulp and Paper Company have just completed a 100-ton ground wood pulp mill located on the Spanish River at Espanola, Ont. The hydraulic power development was greatly facilitated by nature's provision of a natural fall of about 28 feet, which was developed to a head of 60 feet by the construction of a concrete dam above the falls 200 feet long on top and 50 feet high. There are concrete headworks at the forebay, from which are taken five 10-foot penstocks, with provision for the addition of another penstock. The penstocks are provided with vent pipes at each end. It was also necessary to run a canal about 420 feet long from the pond to the forebay. The accompanying illustration shows the penstock work in course of construction.

The wood room machinery is electrically driven by a 250 horse-power motor. The grinders are so arranged that the power unit is direct connected, three grinders being on each side of the unit. The power units each consist of a pair of 39-inch horizontal wheels. In the wet machine room power is also provided by two 39-inch horizontal turbines direct connected to the line shaft.



View of Penstock Work for Spanish River Pulp & Paper Company, Espanola, Ont.

Electrical power is provided by one 200 k.w. and one 110 k.w. Westinghouse generator driven from the line shaft, and a 16x16-inch non-condensing slide valve engine.

The boiler plant for steam purposes consists of three 18-foot 2x60-inch horizontal tubular boilers, with extension furnaces, induced draft being used. Provisions are made for one additional boiler. In the boiler house are placed feed pumps, heater, underwriter fire pump, etc. The plant is heated throughout by steam coils. The water supply for process purposes is taken from the penstock and runs through a pressure filter.

The turbine water wheels, head gates, racks and sand gates were furnished by the Holyoke Machine Company, Holyoke, Mass. ; the steel plate penstocks and tubular boilers by the Jenckes Machine Company, Sherbrooke, Que. ; penstock gate valves and slide valve engines by the Waterous Engine Works Company, Brantford, Ont., ; the electrical machinery by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. ; the power transmitting machinery by the Goldie & McCulloch Company, Galt, Ont. ; hand power crane by the Smart-Eby Machine Company, Hamilton, Ont.

THE ELECTRICAL TRADES ASSOCIATION OF CANADA.

About two years ago there was organized The Electrical Trades Association of Canada, Limited, the promoters being gentlemen associated with the electrical industry. According to the constitution, the object of the association is to promote a more cordial feeling among the members ; to protect their mutual interests ; to settle differences among its members whenever possible ; to collect trade information and distribute it among its members, and to protect them from making unsatisfactory credits.

Mr. W. V. Shaw,
President Electrical Trades Association of Canada.

The second annual meeting of the association was held at the Windsor Hotel, Montreal, recently, at which the following officers for the ensuing year were elected : President, William V. Shaw ; vice-president, John A. Burns ; honorary secretary-treasurer, J. Augustine Mann ; executive committee, John Forman, W. V. Shaw, John A. Burns, Edward Sise, J. A. Dawson, all of Montreal.

Mr. J. Augustine Mann,
Honorary Secretary-Treasurer Electrical Trades Association of Canada.

The secretary's report showed that the association had been of great benefit to its members, and from it we take the following extracts :

The New Year of 1904 brings with it many commercial and political revelations, and among the former most nearly brought home to us as a body, may be noted the fact that the Electrical Trades Association of Canada is no longer an experiment but an established institution, based on a solid foundation.

Some of the members have taken greater advantage of the association than have others, and it is needless to say that the former are much more satisfied that they are members than are the latter. As an illustration of this last remark I would point out that one member of the association who has used it fairly well listed eleven delinquents, representing $832.31. Of these eleven, six paid in full and two paid something on account, leaving three only who are still listed, one of whom has gone out of business but who has furnished security for payment of the debt, leaving out of eleven delinquents reported only two who have not been reached by the association, one of whom is well recognized by the electrical trade to be "very poor pay."

Up to date I am not able to report any additional members, but two of the largest electrical concerns in the city have requested a copy of the by-laws and forms, and will, undoubtedly, become members within a very short time.

May I reiterate in closing, a statement which I made at the last annual meeting, namely, that the members of the association do not use it as they should, and that if they did they would derive benefit from it far in excess of their most sanguine expectations which I believe to be the evidence of the members who have made a diligent and proper use of the association forms.

HIGH SPEED RAILWAYS IN EUROPE.

Mr. Charles Brandeis, consulting engineer of Montreal, who recently returned from a business trip to Europe in connection with an electric railway and lighting plant in China, states that all the large electrical manufacturing concerns, especially in Germany, claim to be very busy, in spite of the trade depression which is known to have existed there for the last few years, but that they get low prices for their goods. Trade, however, seems to be improving. The larger towns have good electric car service, but long distance electric railways are hardly known, except in the Swiss Mountains and its neighborhood where water power is available. As the railways are operated by the Government there is probably little prospect of long distance electric railways being introduced in the near future. An interesting high speed electric railway has been tried near Berlin on the military railroad to Zossen.

This is an experimental three-phase railway not intended for public use, built by a company with the assistance of the firms "Siemens & Halske" and the "Allgemeine Electricitats Gesellschaft" and supported by the German Government. Through the courtesy of the directors, Mr. Brandeis was enabled to see the details of this system. On a straight road the cars attained a speed of 130 miles an hour, and around curves of 2000 metres radius a speed of 100 miles per hour. The cars travel easy without any evidence of danger and thus the feasibility of high speed railways has been demonstrated. The principal objection is the great cost of installation and maintenance. It has been estimated that such a train service between Hamburg and Berlin, a distance of only 185 miles, would entail an expense of 50 million dollars.

The cars used are pointed in front to minimize air pressure, and the wires are not overhead, but at side. It was found that overhead wires were not a success. The revolving wheel is also dispensed with. Three wires are used, and there are two styles of poles. The speed of 130 miles is purely an experimental one, and to prove that it will be quite safe to adopt a speed of say 60 miles an hour for general traffic.

Mr. Brandeis also took occasion to make a special study in England and Germany of water filtration plants for the large cities. Sand filters are generally used, by which a high degree of purity and sterilization of the water is attained. At Berlin the volume of water passing through the sand is about 200 gallons per hour per square yard, with 4 feet thickness of sand and stone. In London the volume is about 280 gallons per hour per square yard, with thickness of sand and stone 5 feet. This entails the necessity of very large filtering area at a cost of about $17 per square yard. Sterilization of water on a large scale is also being done electrically by means of ozone. Water containing 39,000 germs and more of bacillaie per cubic centimetre is sterilized to such an extent that practically no germs are left. The ozone does not affect the water in any way, the latter remaining odorless and tasteless as before. This system has been installed in the towns of Paderborn and Wiesbaden, the former having a capacity of 11,000 to 13,000 gallons per hour, the latter a capacity of 55,000 gallons per hour. The cost of sterilizing with twelve working hours daily is estimated with the cost of coal at $4 per ton as follows: With a plant capacity of 45,000 gallons per hour, about 3½ cents per 1000 gallons; with a plant capacity of 450,000 gallons per hour about 1 cent. per 1,000 gallons. This includes four per cent. for interest on capital and three per cent. for sinking-fund. With water power the cost would be less. Should filtration be desirable to remove the dirt, then since the germs have been killed with ozone, this may be done at the rate of 1,100 gallons per hour per square yard, which is about 5 times the speed allowed where the sand filters have to retain the germs also. Where ground is expensive, this is, of course, a very important item. According to Berlin statistics, the average consumption of water per head of population is 100 litres per day, the water being charged according to consumption as indicated by meter. At Hamburg there are no meters and the average consumption runs as high as 200 litres per day per head, showing the great amount of waste.

CANADIAN MINING INSTITUTE.

Among the papers read at the recent annual meeting of the Canadian Mining Institute, held in Toronto March 2nd, 3rd and 4th, were the following: "On the Construction of Mine Bulkheads," by William Thompson, Rossland, B. C.; "Exhaust Steam Boiler Feed Water Heaters" and "Hot Water Pumps and Pumping," by W. D. L. Hardie, Lethbridge, N.W.T.

The ratepayers of Edmonton, N. W. T., have endorsed the agreement entered into between the Town Council and Mr. W. G. Tretheway, of Montreal, by which the latter undertakes to build an electric railway in Edmonton. Mr. Thetheway agrees to build nine miles of road.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Mr. Arnold's Railway System.

The last few months have been rich in literature on the alternating motor for traction purposes, such as descriptions of the experiments made in Germany on extremely high speeds, and by Finzi in Italy and the Westinghouse Company on this continent on the single phase type, one of the latest and most interesting contributions being a sketch of the system devised by Mr. B. J. Arnold, and with which he has been experimenting for some time. Briefly stated, the design embraces a multiphase or single phase motor, preferably the latter, geared to the car axle in a somewhat similar manner to direct current practice, this motor being designed of a size sufficient to supply not the maximum but only the average requirements of the car. Further, by means of the special appliances provided, it operates with the rotor and stator moving at an approximately constant speed with relation to each other, the load on the motor being always the same, the machine therefor operating all the time at its maximum efficiency. This extremely novel and most desirable result is attained by the following ingenious arrangement, viz : The armature or rotor is geared to the car axle in the ordinary way, in addition being connected to an air compressor cylinder by means of a crank rod and pin, the latter mounted on one face of the pinion. The field, or stator, instead of being rigid, as in the ordinary construction, is also free to turn, and is connected in a similar manner to another air cylinder. In addition to the foregoing, air storage tanks are provided, together with the valve mechanism necessary to make the compressors reversible, so that either or both can be worked at will as either engines or compressors. From this it will at once be seen that from the normal condition of the rotor revolving, the field being stationary, the car then operating at what might be called synchronous or standard speed, it can be run above this speed by driving the field backwards by means of its cylinder working as an engine, supplied from the storage tanks, with or without engine help from the armature cylinder, or on the other hand can be brought to a standstill by so manipulating the valves as to completely throttle the cylinder attached to the rotor, the other then acting purely as a compressor, delivering its product to the storage tanks.

In its experimental stages the system appears to present many advantages. For instance, the control being purely pneumatic the speed graduation is of necessity infinitely fine, and attained with the minimun of apparatus. There being none of the motor circuits opened at any time, this may be of the simplest possible construction, and wound for any suitable voltage, besides being of comparatively small size, seeing that it is designed for average instead of maximum requirements, the difference being supplied by the stored air. Braking is accomplished with the maximum of efficiency, seeing that all that has to be done is to turn the rotor cylinder into a compressor. The car can be operated for a limited time without potential on the line, the air storage being sufficient to supply it for a short period. This feature would be extremely useful when switching, or during temporary interruptions to the power service. Another most valuable point is that the load being constant on the motors, it must also be constant at the power house, a matter which has only to be mentioned to be appreciated. Altogether, the scheme presents many features which appear to be most attractive, and therefore further experiments will be awaited with great interest. These were in progress on a road running from Lansing to St. John's, Mich., but were unfortunately interrupted by a fire which destroyed the first equipment.

Street Car Brakes.

In these days when heavy electric cars and high speeds are rather the rule than the exception, the ability to make a quick stop is a prime requisite of the equipment. Not only is this necessary when working to a schedule, that is under traffic conditions, but also in cases of emergency, when its presence may, and in many cases does, prevent what would otherwise be a bad wreck. This means that the day of the ordinary hand brake is past and over for this class of work, even if that device has not already gone beyond its legitimate bounds in city service. That this is true will at once be evident when one compares the best stop it will enable one to make with the average results from a power equipment ; the difference in favor of the latter is enormous, even when the schedule alone is considered, omitting entirely the greater freedom from accidents.

Once given the field for any device it does not take long to produce various designs each of which it is claimed is a satisfactory and final solution of the problem, and so we find that for many years there have been on the market power brakes for electric cars, the two most prominent types being operated one by compressed air, the other by electricity. Besides these there is that class sometimes known as momentum brakes, or that type utilizing the energy of the moving car, through suitable mechanical connections, as the actuating force of the brake mechanism. In addition to these the early days of steam railroading witnessed the introduction of a spring actuated form, the novel feature of which was a spring spiralled round each brake mast and set by the brakeman, a cord running through the train to the engine allowing the driver to simultaneously trip all the springs, which then wound up the brake chains.

In air brake work there are two distinct methods of working, straight and automatic. The main feature of the latter consists of means whereby any leak in the piping or break in the train will set the shoes, whence the name automatic. In other words, the brakes are set by decreasing the pressure in the train pipe, instead of increasing it, as would at first sight appear to be the logical method. This result is, of course, not obtained without increased cost and greater complication, but nevertheless it was the type quite frequently selected when air brakes were first supplied to electric cars. Experience showed, however, that the disadvantages far outweighed the benefits, and consequently the majority of air braked electric cars are now being put in with straight air, which as the name implies, acts simply by letting air from the reservoir through the train pipe into the car cylinder.

In the matter of supplying the requisite air pressure there are also two distinct practices, one to put a small motor and air pump in each car, controlled by an automatic governor, and running only when the pressure goes below a certain pre-determined limit, the other a central energy or storage system, in which all the compressing is done by one or two larger and stationary equipments, located at points adjacent to the track. The individual system is ideal in theory, and at first was practically the only one used; to-day it is being hard pressed by the other type, which, owing to its lesser first cost and maintenance accounts, besides its increased efficiency and reliability, will in all probability supersede the former for all but the longest runs.

The electric brake has been developed very satisfactorily in that form wherein current from the motors operating as generators is used to energize a magnetic clutch, one member of which is stationary on the motor frame, the other revolving with the axle. This is the system adopted by the General Electric Company, the Westinghouse interests having lately developed an electric track brake, the main features of which are that, unlike other brakes of this class, the pressure available from the friction between the rail and shoe is used to set other shoes against the wheels, thus obtaining extra braking efficiency. At the same time nothing is lost by the reduction of the weight on the wheels, as in most mechanical track brakes, this if anything being increased, as the shoes are magnetically attracted to the rail. Current for operation is obtained by running the motors as generators, the same source of power being utilized to heat the car if desired. In both systems the braking action is obtained by a backward motion of the main car controller.

The momentum type consists in the main of a friction clutch, operated by the motorman, which, when closed, winds up the brake chain onto a drum. The idea of utilizing the energy stored in the moving car, and which would otherwise be wasted, as the means of actuating the brake mechanism is of course ideal. Whether or no the mechanical method of transmission is the better one, as compared with the electric, remains yet to be proved.

EMPLOYEES' BANQUET.

The employees of the Toronto Electric Light Company held a banquet in St. George's Hall on Tuesday evening, March 8th, when about two hundred sat down to dinner. The assembly room was beautifully decorated with colored lights and bunting, with the initial letters of the company prominently displayed over the head of the table. The toasts included "The King," "Our Guest," responded to by Mr. J. J. Wright, manager, and Mr. W. A. Martin, secretary of the company ; "The Operating Department," by R. G. Black, Mosely and Thomas Wright ; "The Office Staff," by H. Amos, and "The Ladies," by Herb. Terry. The committee in charge was made up of Messrs. William Corrigan, chairman ; W. H. Blizzard, secretary-treasurer ; F. W. Newton, James Tetley, Wm. Froud and H. E. Terry.

Messrs. A. R. McDonald, broker, Thomas Migner, manufacterer, Charles Bergevin, gentleman, all of the city of Quebec, and others, have asked for the incorporation of the Quebec Electric Company, to install an hydraulic electric plant on the St. Fereol Seven Falls, on River Ste. Anne, in the County of Montmorency, and to build an electric railway from Seven Falls to the City of Quebec.

SAFEGUARDS AND REGULATIONS IN OPERATION OF OVERHEAD DISTRIBUTING SYSTEMS.*

By W. C. L. Elgin.

The distributing system can be considered as one of the integral portions of a power plant and it should receive as careful attention as either the steam plant, hydraulic plant, or the electrical plant in the generating station or sub-station. In fact, it would appear that the transmission system has to meet more severe conditions than any other part of the entire plant, so that the safety and reliability of the service depends largely upon the amount of forethought given to the plans and to the selection of material.

When it is considered that an overhead dirtributing system is subjected to many varied conditions, such as the weather, extreme changes of temperature, extraordinary storms, interference from other lines, interference by building operations, excavations, fires and other casualities, and sometimes a wilful interference by the public (not to overlook the small boy with a stone), it should be readily appreciated that all of these varying conditions must be considered in the construction of the line. There are two divisions of conditions : First, the mechanical or structural features, and secondly, the electrical features.

The first group will include the study of the territory in which the line is to be run, width of streets, kind of buildings, height of buildings ; other distributing systems, possibilities of interference with these systems; amount of power to be transmitted, and whether the system consists of a simple power transmission circuit or one complicated with distributing mains covering the larger part of the territory occupied by the transmission system.

Also to be considered are the weather conditions ; wind storms, rain storms, sleet storms, snow storms, lightning storms, and changes in temperature from summer to winter. The method of erecting the conductors so that they can be properly repaired or additions made without endangering the lives of the men engaged in this work must be carefully planned. Unless these various points are all considered in the construction of the lines, no rules or safeguards for their operation will be of material benefit.

The second group includes the electrical requirements ; the conductors, the insulating method of support, and the means provided to take care of any undue disturbances due to lightning or other causes on the line, such as lightning arresters, fuses, switches, etc.

SPECIFICATIONS FOR MATERIAL TO BE USED.

All of the material entering into the construction of a transmission system should be ordered under specifications which shall clearly set forth the character of the material to be used and also that all of the material will be inspected before it is used on the work, and that tests will be made of samples of all materia furnished. The more general requirements are as follows:

Poles.—Poles should be as short as possible to meet the conditions and preferably made of good sound chestnut. Southern cedar and pine poles are sometimes used when chestnut is not obtainable. It may also be necessary to use iron poles under certain conditions ; but iron poles are to be avoided, principally on account of danger to linemen and also to the short life of the pole, due to rusting. The pole should be roofed at the top to form a right angle, and gained to form a flat of about 5 inches for the attachment of the cross-arms.

All poles, upon which are located devices requiring regular inspection, should be provided with steps in order to facilitate this work. Spacing of the poles should be carefully considered and should not exceed from 40 to 45 yards. End and corner poles should be braced, and at least every tenth pole throughout the line should be guyed with ¼-inch or ⅜-inch standard galvanized wire. Regular inspections, at least annually, should be made of the conditions of the poles, which is most readily determined by examination at the base of the pole. When poles are used as junction poles, that is, when lines are run at right angles and attached to the same pole, special care is necessary. A separate drawing should be made of all such poles, showing the arrangement of the wires—keeping in mind the simplest possible arrangement—as a protection for the men who climb these poles. Switch-boxes, fuses, lightning-arresters or transformers should not be attached to such poles but on the first pole removed from the junction pole. Junction-poles can frequently be avoided by the use of two poles making a "Y" connection of the line. By this arrangement the connections are very materially simplified.

Cross-arms.—Cross-arms should be spaced at least 24 inches between centers, the top of the first arm being one foot from the top of the pole.

Braces.—Braces should be made of galvanized iron not less than 1¼ x 3/16 inches thick and about 28 inches long.

Pins.—The pins should be made of locust wood well boiled in linseed oil, and are perferable for voltages of 5,000 volts and under. For higher voltages pins should receive special consideration.

Insulators.—The insulator on the pole line fulfils two functions, viz.: the mechanical support of the line, and the insulation. As these conditions vary over a wide range, they must be considered for each condition. This is especially so for voltages of 10,000 volts and over. The two materials of which insulators are usually made are glass and porcelain. The glass insulator is more uniform in quality of material than the porcelain, so that for lower voltages glass insulators are recommended. For higher voltages porcelain insulators are preferred, for the following reasons : Greater mechanical strength, better insulating qualities, and greater ability to withstand severe weather conditions.

Insulators of high voltages shouble be made up of a number of insulators cemented together so as to obtain more uniform insulation and to increase the factor of safety from defective manufacture. Before being used, each insulator for high tension work should be tested at voltages in excess of the operating voltage.

The method of attaching the conductor to the insulator should be carefully considered : First, to see that the wires can be properly fastened to the insulator, and secondly, to see that the strain is transmitted without a twisting or bending strain in the insulator ; the only strain permitted should be in compression.

The method of distributing the wires on the pole lines depends on the number and character of the various circuits to be installed. For all voltages below 6,000 volts, the wire should be brought out of the station through long porcelain tubes, properly supported; the various circuits being grouped together but well spaced, and preferably being distributed in a single, or not more than a double row of wires. This fan effect allows the circuit to be distributed to the poles without any undue bunching, thus making each circuit easily distinguishable.

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* Read before the American Institute of Electrical Engineers.

The top gain of all poles should be left vacant so that guard-wires can be placed at any point on the line, should they be required. The transmission circuits which are alive 24 hours per day should be placed on the top arm; that is, the trunk lines should occupy the position where there will be the least liability of coming into contact with the other wires or with the men working on the poles. All other circuits should be placed below series arc circuits occupying the lower arms, the distributing series circuit being placed on the house of the lower arms on an outer pin occupied by such circuits. The bottom cross-arm should be used for such secondary circuits or low-tension lines as may be required. Space should always be provided for an extra arm on the pole for the erection of a transformer. Protective devices for each circuit may be classified as follows: Circuit-breaker, fuses for branch circuits, and lightning-arresters. Also indicating instruments as follows: Voltmeter, ammeter or wattmeter, and ground-detectors.

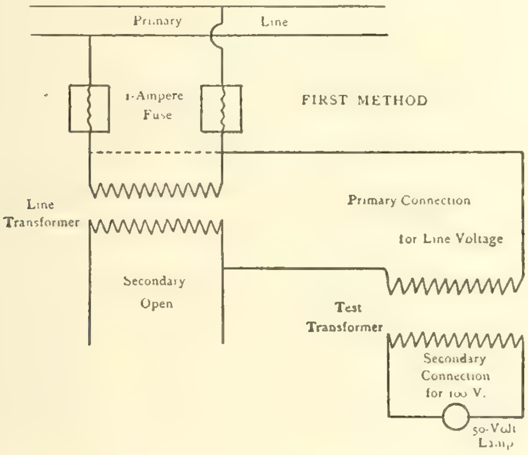


FIG. 1.

In the arrangement of the protective devices, it is desirable to locate as many of these as possible in the station or sub-station, for the reason that they are more readily inspected and kept in perfect working order, which insures the fulfilling of their functions when required. All circuits of 200 k. w. capacity or over should be protected by means of oil circuit-breakers in preference to fuses, on all voltages over 1,000 volts. These circuit breakers should be attached to both ends of the line, when two or more feeders are used and connected to the same bus; and there should be no other circuit-breaker or fuses which are automatic in action placed at any other part of the line. Small branch-circuits may be taken care of when necessary by fuse-boxes, placed upon the first pole of the branch circuit. These fuse boxes, however, should be avoided whenever possible. This can be accomplished by making a branch circuit about the same as the main circuit, depending entirely upon the circuit-breaker in the station to protect both lines. When small branch circuits are desired, place such fuse-boxes. These preferably should be an enclosed fuse of the cartridge type mounted on a porcelain base, the whole enclosed in a fireproof and waterproof compartment. This is usually an iron box with a cover and rubber gasket, clamped so as to make it water-tight.

Lightning Arresters.—Lightning arresters should be installed at both ends of the line, in the station and sub-station, on each conductor. Special care should be used in their installation, and provision made that in the event of a break-down of the lightning arrester, current may be interrupted by means of a circuit-breaking device.

Series Arc Loop Cut-Outs.—These should consist of a mechanically operated switch which closes the circuit at the point of the loop and disconnects the loop from the main line. For the use of constant potential circuits, there may be either a fuse-box provided with solid catches or fuses depending on the conditions. All of these devices being enclosed in fire and waterproof cases.

Before considering the actions of the safety-devices, it is necessary, first, to examine the faults which may develop and the functions which the safety devices are required to fulfill. In the condition of a wire parting is first considered, we have first the liability of the wire coming in contact with some of the other circuits; secondly, its liability to fall into the street, and thirdly, its remaining suspended clear of all circuits and the ground.

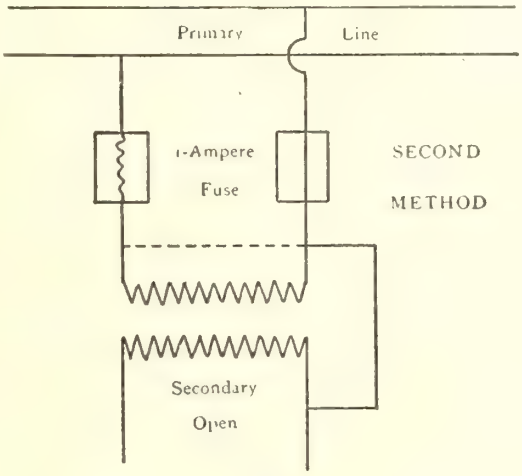


FIG. 2.

The first condition: The effect of coming in contact with other wires, would immediately raise the voltage to the more powerful of the two circuits, so it is evident that the insulation of the other circuit must either be as good or there will be a liability of the insulation breaking down at some point on the weaker circuit. This will first be detected at the station by showing that the load is dropped from this circuit; and it demonstrates that the insulation of all circuits must be the same when placed on the same pole-line, unless means are provided to take off extraordinary high voltages. This can be done by placing spark-gaps, which will relieve the high-tension from any low-tension circuits, or by grounding a point on the lower-tension circuits.

Wires falling on the ground will indicate immediately in the station on the ground-detector that there is a ground on that circuit, and instructions should be given that as soon as a ground shows on the circuit and the circuit is not carrying the load, to disconnect it

The third condition will indicate in the station that the load is dropped and will not show a ground. The circuit should be cut off in this case also, and inspectors sent out to look after the trouble.

Fourthly, if a wire breaks and falls, crossing other wires of the same circuit, this will cause a rush ot current on constant-potential circuit and immediately open the circuit-breaker. In the series arc-circuit it will cut out a portion of the circuit which will be indicated on the voltmeter, showing the necessity of regular voltmeter readings on such circuits.

INTERFERENCE WITH OTHER WIRES FALLING OR COMING IN CONTACT WITH THE POWER-CIRCUITS.—If these wires cross the power-circuit and drop loosely on them, the effect will be to short-circuit the power-circuit on constant-potential circuits; the defect develops immediately. The wires either burn off or an arc may be established which will burn off the power-circuit, breaking the wires and the connection. The provision should be as the conditions shown for the breaking of a wire. A single wire may merely come in contact with one wire ot a constant-potential circuit and assume the same voltage as that circuit; there will be no way of determining this at either the station or the sub-station, unless that wire was grounded and the ground indicated on the ground detectors. In the event of this falling wire coming in contact with both sides of the series arc-circuit, a portion of the circuit will be put out and indicated on the voltmeter at the station. Should it come in contact with only one wire of the circuit no indication will be made at the station unless the wire be grounded. For this reason inspection should be made and all such wires changed so as to come below the power-circuit and not above it. This also demonstrates the necessity of placing protective-devices on foreign wires which may come in contact with power-circuits.

LIGHTNING-STORMS.—The installing of efficient lightning-arresters as specified may protect the apparatus at both the generating station and sub-station, but fail to protect apparatus at intervening points, particularly the transformers. It is possible that lightning may jump from primary to secondary of transformers during a severe storm. This would be indicated by the primary fuse blowing in the transformer, and after the blowing of the fuse from this cause, tests should be made of the transformer as follows:

It is essential that when a primary fuse on a transformer is blown through any cause, the secondaries should be disconnected from the transformer, and the latter tested to full-line voltage between the primary and secondary coils, so as to determine that there is no breakdown in the insulation between these coils.

There are two methods by which these tests may be readily made by the linemen without removing the transformer: First, take from the station a 600-watt transformer, connect its primary for the line-voltage and its secondaries for 100 watts, and connect a 50-volt lamp across the latter. Attach one primary lead of this test-transformer to one secondary wire of the line-transformer, and place one-ampere fuses in the primary cut-outs protecting the line transformer. Now connect the other primary lead of the test-transformer, first to one and then to the other of the main primary lines. If the 50-volt lamp filament becomes red, the line-transformer is defective, and should be returned to the station. Second method: If impossible to use the first method, proceed as follows: Attach a short piece of heavily-insulated rubber wire to one of the secondary wires leading from the transformer. Then place one-ampere fuses in the cut-outs, and connect the specially insulated rubber wire first to one and then the other of the main primary lines. If the fuse blows, or a spark shows when contact is made, the transformer is defective and should be removed from the line.

In the event of lightning-arresters being placed on the pole line, all such lightning-arresters should be inspected after each heavy lightning-storm.

TRANSFORMERS.-Transformers when supported on the poles should be hung on a extra cross-arm provided tor that purpose. The primary leads from the line to the fuse-box and to the transformer should be insulated with rubber-covered braid, for the line voltage. Transformers should not be attached to buildings or in such locations as to be handled by unauthorized people and when they are placed in buildings they should be put in a separate fireproof closet or room which is controlled only by the operating plant. As it is now the general practice to use oil-transformers, it is unnecessary to consider dry-transformers. Inspection should be made to see that the cases are properly filled up with oil. This should be done by an inspection force, and not by the men erecting the transformers.

INSPECTION.—The greatest safeguard in a transmission line is regular inspection. Lines can with advantage be inspected daily, not only an inspection from the ground, but a regular monthly inspection of all devices attached to the line when a continued service is desired.

It may be necessary on some parts of the line to introduce cable. This should be avoided whenever possible for the reason that the conductors are brought close together at this point and static discharge is liable to puncture the insulation; so means should be provided at both ends of the cable to take care of the static. This is best arranged for by a series of gaps of the lightning-arrester type. Standard lightning-arresters can usually be used for this purpose. They should, however, be provided with a small fuse in series with the connection to the line so as to prevent short-circuiting the lines in case of failure of the spark-gaps.

JUDGMENT AGAINST THE KINGSTON LIGHT, HEAT & POWER COMPANY.

In 1901 arbitrators valued the plants of the Kingston, Light, Heat & Power Company at $170,373, allowing nothing for the franchise, which the company valued at $80,000. The company appealed to the Privy Council in England in the hope of being allowed something for the tranchise, but the appeal has just been dismissed. The company fought in the hope of saving something for the shareholders, who paid in $120,000 as capital. The award of the arbitrators would give $100,000 to bondholders, and $55,000 to wipe out floating liabilities, leaving $15,000 for the shareholders.

If a boiler is not required for some time, empty and dry it thoroughly. If this is impracticable fill it quite full of water, and put in a quantity of common washing soda. External parts exposed to dampness should receive a coating of linseed oil.

THE BREMER ARC LAMP.

This lamp seems likely to make a stir in the arc lighting world. There are, moreover, says the Electrical Magazine, signs that it will not escape the fate of the successful invention, and that its imitators will be numerous. Whether it constitutes anything in the shape of a master patent, time alone can show. Ingenuity is being displayed in connection with this matter by various persons in various ways. The ingenuity of inventors from the electrical and mechanical points of view is great, but legal ingenuity is often quite as admirable. There seems every likelihood that legal ingenuity will play a large part in connection with these arc lamps. Briefly put, it appears now to be known that, under certain conditions, various substances can be mixed or incorporated with the carbon used in the manufacture of the arc electrodes with the object of improving the character of the light emitted. Not only so, but it is claimed that the actual light-emitting efficiency can be increased, and that the light itself is more pleasant to behold. Probably we shall also be told sooner or later that the colour of the light is more healthy or more suitable for reading purposes or for matching colours. In fact, when once a thing is on the road to commercial success, there is no limit to the advantages that the exploited article possesses. With regard to the Bremer arc lamp, it seems highly probable that Herr Hugo Bremer did really make improvements which have utility. That seems to be admitted by the various interests who are supposed to cast envious glances at his lamp. On the other hand, a spirited dispute might perhaps be raised about the question of novelty. This is always a dangerous sea on which to embark ; and the inventor himself probably learns much to his dismay during his voyage on what are probably to him unexplored seas. Then again, quite apart from these, there arises the question of legal ingenuity, pure and simple. Even supposing the invention has both novelty and utility, did the inventor so word his specification and his claims in such a way as to completely baffle the ingenuity of any person who has designs against him? Is there indeed no weak spot in his armour? Herr Bremer seems to have misgivings on this point, and it is therefore of interest to notice the claims made in the original specification, and the amendments which he has wished to make. His original claims were :—

(1) A carbon electrode for arc lamps containing in addition to 15 to 60 per cent. of aluminiferous metal or metallic base such as calcium or magnesium, at least 5 per cent. of fluorine, in the shape of a suitable compound, substantially as described, and for the purpose specified.

(2) A carbon electrode for arc lamps containing in addition to a luminiferous base at least 5 per cent. of iodine or bromine, in the shape of a suitable compound, substantially as described, and for the purpose specified.

(3) A carbon electrode for arc lamps containing in addition to luminiferous metal or base, at least 5 per cent. of fluorine, iodine or bromine, in the shape of a suitable compound, and a compound of boron, potassium or sodium, which have been added to the carbon mixture in a calcined condition, or free from water of crystallization, substantially as described, and for the purpose specified.

(4) A carbon electrode for arc lamps containing from 10 to 60 per cent. of calcium fluoride, uniformly mixed with carbon, substantially as described, and for the purpose specified.

(5) In the mineralized carbon electrodes for arc lamps, the combination of an upper electrode with a lower electrode having a glassy coating as and for the purpose described.

As amended Claims 2 and 5 are to be omitted. In Claim 1 the words "metal or metallic base such as" are to be changed to "metallic salt, such as a compound of"; in Claim 3 the words "metal or base" are to be replaced by "salt," and the words "iodine or bromine" are to be omitted.

A few alterations are also proposed in the main body of the specification. The following particulars are taken from the specification, and describe the general nature of the invention. The specification is numbered 14,704 of 1899. The inventor says that attempts to mix salts of calcium, magnesium and strontium with carbon have hitherto failed, partly because unequal distribution throughout the mass causes fluctuations in burning, and partly because the slag produced forms eventually a solid ring at the tip of the electrode and extinguishes the arc. Of course, a high percentage of the luminiferous metallic salt was impossible. He asserts that the necessity to calcine the salt for the purpose of removing the water of crystallization, and so avoid rendering the electrode porous, was unknown. The difficulties arising from the formation of slag are avoided by the addition of a flux, which fuses at the temperature of the arc, absorbs the basic slag, and then falls off in drops or small particles. Flux and metallic salt may be chemically combined, as in the case of calcium fluoride, in the use of which lies one of the main points of the invention. Fluorides are said to be the most useful salts for mixing with the carbon. In particular, preference is given to calcium fluoride and cryolite, i. e., aluminium sodium fluoride. Calcium fluoride produces a stronger and more agreeable light than that obtained with calcium chloride or other calcium salts ; the slag too produced by the fluoride is more or less liquid, instead of being hard and solid like the slag produced by other calcium salts. The fluoride should be at least 5 per cent. of the carbon, and the luminiferous metallic matter should be preferably from 25 to 30 per cent. of the carbon. The use of bromides and iodides, which was suggested in the original specification, seems now to be abandoned. Electrodes containing calcium fluoride or magnesium fluoride are apt to give a flickering light unless this tendency is counteracted by adding some boric acid, borax, potassium silicate, or carbonate, sodium carbonate or silicate, all of which presumably exercise a binding action.

The next point is to indicate a method of dealing with the slag, which forms a molten viscous liquid. This falls from the upper electrode and accumulates around the tip of the lower carbon, unless steps are taken to prevent this. In the Bremer lamp, it is prevented by the simple expedient of coating the carbons with a glassy covering of borax, or a silicate, or other suitable material, to use the language dear to the heart of the patent agent. The drops therefore slide down the lower carbon without producing any ill effect and without having a tendency to stick to the carbon.

These, then, are the outlines of the invention, and if the tests which have been published on the light-emitting properties of carbons prepared in this way should be substantiated in practice without any subsidiary ill effects, one can well understand that the above specification will be anxiously overhauled by those who are interested in the manufacture of arc lamps.

INDUCTION VS. COMMUTATOR WATTMETERS.

The recording wattmeter is a fairly accurate instrument. In a recent compilation, over 500 tests made at random among the wattmeters of a very large metropolitan plant, only 5 per cent. showed an error greater than 2 per cent., and most of them were well within 1 per cent. From a point of accuracy, there is not very much to choose between recording wattmeters of good reliable makes, but there are advantages in favor of commutator and induction types which are worthy of consideration. The commutator type has the disadvantages of its commutator. The friction of its brushes is a source of error, and in common with all things possessing commutators, it has troubles of its own which are inherently due to that device. It is moreover an instrument with heavy moving parts and requires a greater wattage to start it, and more current in the potential circuit to drive it. These comprise the sum of its principal disadvantages.

The advantages are worthy of consideration, and in some cases practically decide its adoption. In the first place it is a universal instrument. It works with equal accuracy on alternating or direct current and is independent of frequencies. In central stations where there is a possibility of changing the service or where the service is mixed, it is the instrument that should be selected. It is, as a rule, a heavier instrument and more expensive to manufacture. Commercial conditions are such that the expense of manufacture does not make a large difference to the central station manager, for the makers of commutator instruments are compelled by reason of the competition of the induction instrument, to accept a little less profit on their product. The induction meter, on the other hand, is simpler, has lighter moving parts and requires less potential current to drive it. Its accuracy depends entirely on the frequency and voltage, and it will not indicate on direct currents. Therefore it should only be adopted where the system has been decided as a permanent fixture. Its cost of maintenance is low and its adjustments are very permanent, but the possibility of error due to the variation of the frequency and voltage is quite as great as the possibility of error of the commutator meter by reason of the imperfections of that device. The general solution of the problem seems to be as follows:

Given an alternating plant of fixed frequency and good engine voltage regulation well established and not likely to change, an induction wattmeter is suitable. Given any other plant, recourse should be had to the commutator instrument.—The Central Station.

Tenders are invited by the Dominion Government up to March 28th for electrical apparatus for the Welland Canal. Mr. Roderick J. Parke, of Toronto, is consulting engineer.

The Sunbeam Incandescent Lamp Company, Toronto, are presenting their customers with a neat, gold-plated miniature incandescent lamp, which can be used as a watch charm. It will be sent to users of incandescent lamps or upon mention of the ELECTRICAL NEWS.

OBITUARY.

Mr. F A. Folger, sr., manager of the Kingston Light, Heat & Power Co., died on Thursday, February 25th. He had been confined to his residence for the previous six weeks, and for some years was a sufferer from locomotor ataxia. The immediate cause of his death was heart trouble. The late Mr. Folger was born in Cape Vincent, N.Y., fifty-five years ago, and when young came to Kingston with the others of the since celebrated Folger family. He soon became prominently identified with the commercial interests of Kingston. For the past ten years he has been manager of the Kingston Light, Heat & Power Company and associated with the Kingston, Pembroke & Cataraqui Electric Railway Company and the Thousand Island Steamboat Company. He was a man of kindly thought and happy deed. Few knew his benevolence; few knew how he scattered that it might bring gladness and sunshine to others. He married Miss Mary Coverdale, daughter of a former city engineer of Kingston, who, with four children, survive him. Mr. B. W. Folger, manager of the Kingston, Pembroke & Cataraqui Electric Railway Company, and Mr. M. H. Folger, president of the Thousand Island Steamboat Company, are brothers of the deceased.

THE LATE MR. F. A. FOLGER.

WATER POWERS OF LOW HEAD.

In Switzerland the electrical engineer is steadily co-operating with the water power engineer, and all over the country, writes Philip Gibbs in the London Express, electrical installations are rapidly increasing in number, so that already the largest and most prosperous factories derive their motive energy from these means. The rivers and falls of Switzerland are, of course, mere driblets compared to those of Canada, the United States, New Zealand, Norway and Sweden, India, and Central and Southern Africa, where the great sources of the world's waterpower are stored.

But Professor Steiger, who is largely responsible for the Swiss installations, expresses the opinion that "excellent results may be obtained from a very low fall, even so low as three feet." This distinguished engineer has arranged a turbine installation at Brantham Mills, near Manningtree, in Essex, England. It is a modern flour mill on the banks of the River Stour, which has a tidal fall of four feet 10 inches at the ebb tide. The amount of power required for the electric motors is equal to 40 horsepower, yet this has been produced successfully by a fall of 32 inches. Similar turbines have been erected by this electrician at Norwich, Reading and Lewes.

In Professor Steiger's opinion, a vast amount of waterpower is running to waste even in England, where the rivers are comparatively small and the fall is low.

It must be said, however, that the general opinion of electricians in England, headed by Professor S. P. Thompson, is against the Swiss electrician's opinion that the manufacturing industries of Great Britain may be carried on to any large extent by the waterpower of these islands. They consider that the rainfall is too variable, and the fall of the rivers too insignificant to be a trustworthy source of electric energy. Nevertheless, Mr. Gibbs concludes by the observation that it is not too much to say that the world powers of the future will be determined by the watersheds of the earth's surface.

INSPECTION TRIPS BY ENGINEERING STUDENTS.

It is generally agreed to-day among educators and engineers who have made a careful study of the relation between the technical schools and demands of modern commercial life that it is impossible to prepare an undergraduate student in much more than the fundamental principles of his chosen line of work before he enters upon the actual practice of his profession. Even if it were feasible to supply him with the detailed knowledge which is pretty sure to come with each year of experience, one cannot believe that such training would prove as valuable as the thorough grounding in foundation facts and laws which the best engineering schools now try to accomplish.

In paying all this attention to fundamentals, however, it is a pity to lose sight of the fact that after graduation the embryo engineer is born into a very different life from that enclosed by the college campus. Human nature is about the only undisguised old friend that the young graduate meets when he sets forth to conquer the world with a slide rule in his breast pocket and a diploma in his trunk. If in any way the student can be given what we may call a bird's eye view of the world of pratice we may set it down once for all as a remarkably good investment of time, money and strength.

One of the best ways in which this can be done is by inspection trips to the works and plants of industrial and operating companies. Many of the engineering schools now include these trips as part of their regular curriculum, while others have still to fully realize the benefits which such journeys afford when carried out in a scientific way.

At the outset it is important that both instructors and students realize the need of making these inspection tours stand for something in the way of accomplished work. They had better be omitted than allowed to degenerate into mere junketing expeditions.

The junior year is none too early to begin to make short trips to points of industrial interest in the vicinity of the engineering school. Now and then an afternoon may be profitably spent in visiting the local electric light and railway plants, the telephone exchange, manufacturing establishments, railroad shops, etc. This time may be included in the regular laboratory work if necessary, and can be made as profitable as any other experiment.

After the local field has been covered—perhaps not until the senior year—more extended trips should be undertaken, of course within the limit of the student's means. It would seem that the railroads ought to make substantial reductions in rates to such parties, cutting the round trip fares at least in two. Nor is it essential that the students be coddled in comfort and luxury at the most noted hotels. Common sense economies will readily suggest themselves to the initiated.

When an inspection trip has been decided upon, the professor or instructor who is to conduct the party should make a point of outlining to the students the special objects of interest that are to be noted; the general scheme and economic features of each plant should be gone over; features which distinguish it from other plants of like character should be emphasized, and the general principles of the most important apparatus illustrated in a lecture or two. Thus, in planning a visit to Niagara it would be desirable to exhibit a map of the region illustrating the power developments; to sketch briefly the commercial importance and values of the operating system; to call attention to the various applications of electric power at the Falls, Buffalo, Tonaawanda, etc., and to explain the essential principles of the hydraulic construction, turbines, governors, generators, switchboards, etc. It would scarcely seem necessary to point out the advisability of corresponding with the officials of any company which it is proposed to visit before making arrangements to go ahead.

When the party arrives on the ground the students ought not to be rushed about from place to place as though they were trying to "do" a world's exposition in two days. Sufficient time should be allowed for all to thoroughly see the types of apparatus which are most representative of the highest development and latest practice; to converse with the attendants, engineers and commercial men when feasible; to see how systematically everything is operated; to hear something of burnouts, short circuits, leaks, wastes, breakdowns—in short, to work both eyes and ears overtime in getting in touch with actual operating practice, and seeing in material form the appliances which appeared so abstract in the lectures at home. Then when the student returns to the college or engineering school, he may be asked to write a careful report of the trip in direct, simple English, thereby crystallizing his ideas upon the commercial applications of the scientific principles which he meets in the lecture and recitation room from day to day. Sometimes on these trips a student makes acquaintance with men who are later of great use to him in giving him a start, and in any event it is an inspiration to see in the flesh the world's great masters in any branch of professional work—for glimpses of such men are sure to be caught now and then.

In connection with this last remark it may not be out of place to heartily commend the broad-minded policy of these schools which from time to time invite famous men of one sort or another to lecture before the entire student body. With rare exceptions these leaders in the world's thought always have something worth while to say, and this, coupled with their varying personalities, often makes a deep impression upon the student memory. The lasting benefit may be great.

Concluding, we may safely say that anything which draws the professional school nearer to a broad, general view of conditions in the working, money making world, is worth much. With a careful avoidance of introducing details of lesser importance, the inspection trip may be made so profitable that in after life the student will look back upon it as one of the most instructive and valuable experiences of his undergraduate days.

HOWARD S. KNOWLTON,
Colorado Telephone Company, Denver.

Messrs. W. H. Coverdale & Company have recently been incorporated to do a general engineering and contracting business, with offices at 66 Broadway, New York. Their organization includes engineers of experience in all matters relating to the design and construction of steam and electric railroads, lighting and power plants, coal and ore handling machinery, etc. Mr. Coverdale was for many years in the engineering department of the Pennsylvania lines west of Pittsburg and was track elevation engineer of that company in Chicago during 1898-99. He was also prominently identified with the construction of the Westinghouse shops at East Pittsburg and for the last three years has been civil engineer for a New York firm of engineers and contractors.

QUESTIONS AND ANSWERS

1. Why do the American Institute rules specify that the regulation of a dynamo or transformer is the variation in its voltage from full load to no load? Does it not seem more reasonable to consider it as the fall in voltage when a load is put on, instead of as a rise when the load is taken off?

Ans.—The ruling simply amounts to the establishing of the full load condition as the normal, and as all variations from a normal are expressed in terms of that normal, it will at once be seen that, though it at first sight appears curious, as you say, defining the regulation as the rise in voltage when the load is thrown off is the most correct procedure. The reason for establishing the condition of full load as the normal is that that state of affairs, and not no load, is where the specified results have to be produced, and where trouble, if any, may be expected, hence it is the point or condition where all tests, etc., which form the main subject matter of the Institute rules, are to be applied.

2. Can I transform from three phase to two phase, to run an induction motor, with two standard transformers, or will I have to get tranrformers with special ratios, like those used in the Scott system? At another plant I have a two phase generator. Can I transform to three phase and run in parallel with the first plant?

Ans.—You can use two standard transformers, as you suggest, and operate an induction motor without trouble, though you will not get a true two phase secondary, nor will the voltages be exactly equal, still any standard motor ought to operate perfectly satisfactorily. You can transform to three phase from your other plant if you use the proper ratio of transformers, and have no difficulty in parallel operation, provided your governing mechanisms are sufficiently sensitive. You cannot use standard ratio transformers in this case, because you would not get a true three phase circuit, nor would the three voltages be equal; evidently this combination, in parallel with a true three phase circuit, would give trouble.

3 What are the advantages and disadvantages of exciting direct current generators from the bus bars, instead of each machine from its own armature?

Ans.—The principal advantage is that you eliminate the chance of any machine getting reversed, as sometimes happens with a self-excited generator. There is also the further point that you do not have to wait for the machine to build up when it is being started, as you get full field as soon as the switch is closed. In three wire systems, if you excite both machines from one bus you eliminate possible trouble from reversing, because the separately excited machine cannot reverse, and the other does no harm if it does change, because the polarity of first one reverses with it. Practically the only disadvantage is that you require a larger field rheostat to bring the voltage down to any given point, though this is not usually a material question except in the case of large machines.

4. Can you tell me any simple method for setting the area of a surface of irregular shape, as I often have to calculate this when figuring out the strength of cross sections?

Ans.—If you do not care to buy any of the instruments made for this particular purpose, a simple and fairly accurate method is to obtain a transparent sheet of squared paper, ruled in eights or tenths, lay it over the area to be measured, and count the squares which are thus enclosed. Their number divided by 64 or 100, according to the paper used, will give you the area in square inches with but a small error. It is evident that this method can be applied to the metric system if desired.

5. What is the meaning of the term "High torque," as applied to recording wattmeters?

Ans.—The load on the armature or driving mechanism of a wattmeter can be divided into two distinct parts, namely, that due to friction and that due to the brake or, as they are sometimes called, the retarding magnets. Now, it is evident that if the friction could be kept constant the accuracy of the meter would practically never change, but as this is not possible the next best thing is to make the friction bear as small a proportion as possible to the total load, so that any change in it will represent but a small percentage difference in this total load. The only method of doing this, outside of the obvious one of reducing the friction to the smallest possible amount, is to increase the other part of the load, namely, that due to the brake magnets. Doing this means, of course, that you must correspondingly increase your driving power, in other words have a high torque. Any amount of torque can, of course, be obtained by making the parts large enough and by consuming a sufficient amount of energy to drive them, and so the term is used by the makers of the high torque meter to indicate that by refinement of design and manufacture they are able to produce an instrument having unusually high turning power, and therefore one which will likely retain its initial accuracy in a very satisfactory manner, without the consumption of an unusual amount of energy.

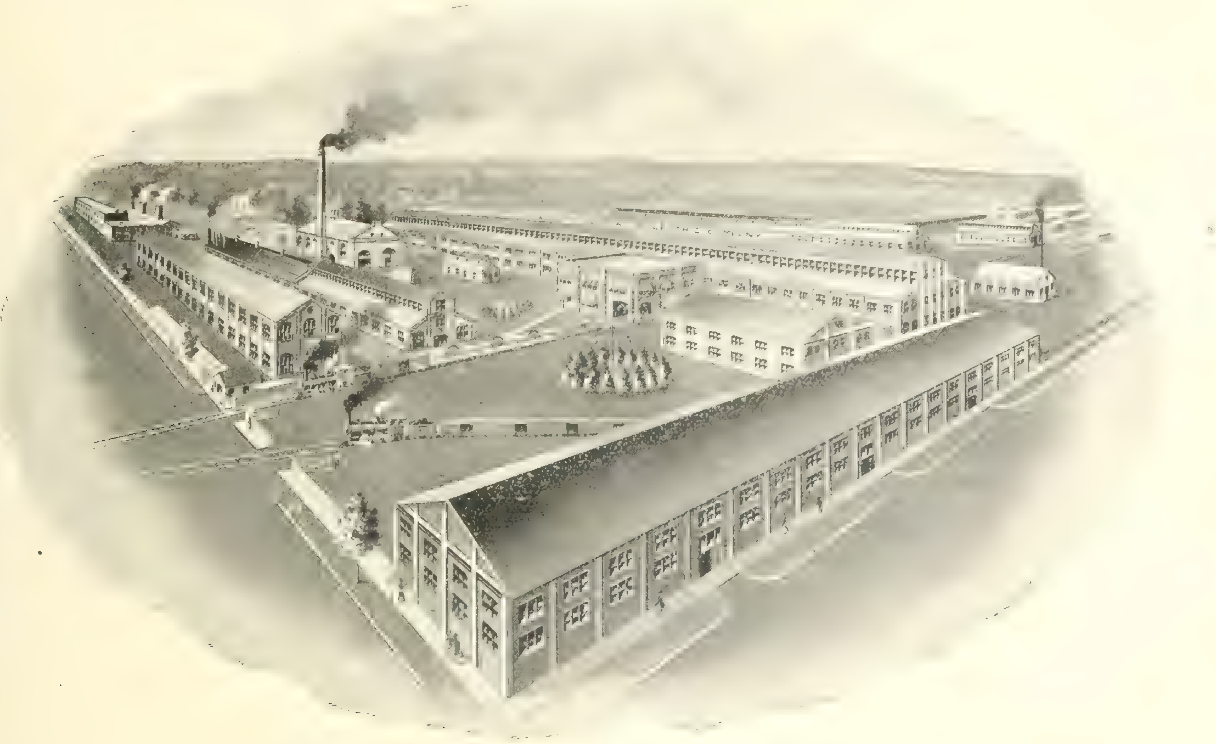
NEW FACTORY OF THE CANADIAN BULLOCK COMPANY.

The entire plant, buildings, and land owned by the James Cooper Manufacturing Company in Montreal have been purchased by the Canadian Bullock Electric Manufacturing Company. The factory has just been erected and consists of a main shop 450 by 100 feet, a foundry 200 by 100 feet, pattern shop 200 by 100 feet, punch shop 100 feet square, and power house 200 by 100 feet, the whole covering an area of thirteen acres. It is located on the Lachine Canal and on both the Grand Trunk and Canadian Pacific Railways. It is equipped with modern tools, and with very slight changes, now under way, can be made admirably adapted for the manufacture of electrical machinery.

The Canadian Bullock Company were particularly fortunate in securing this property, as it will enable them to commence manufacturing immediately on a large scale and to execute orders much more promptly than if new works had to be erected. It is understood that a complete range of electrical apparatus will be turned out.

ANNUAL REPORT OF THE CANADIAN GENERAL ELECTRIC COMPANY.

The report of the Directors of the Canadian General Electric Company, submitted at the recent annual meeting, shows that the company passed through another very successful year. The profits for the year were $512,210.79, out of which two half-yearly dividends amounting to $309,030.94 were paid. Of the balance the sum of $103,132.51 was written off for depreciation, $100,00 transferred to Reserve, and $47.34 added to credit or Profit and Loss Account, which now stands at $80,769.71. The total surplus is now $1,345,539.71.



Canadian General Electric Company Peterboro Works.

From a statement submitted by Mr. Frederic Nicholls, vice-president and general manager, the following particulars regarding the Canadian General Electric Company and the Canada Foundry Company are obtained :

Since the last annual meeting much progress was made towards increasing their facilities. At their Peterboro works a new steel frame building of the most modern construction, 450 x 80 feet, has just been completed, besides large additions to the brass foundry, pattern storage, etc.

At the Canada Foundry Works all of the buildings have been completed with the exception of the boiler shop, which, however, is well forward and should be ready for use in about two months. They are now operating exclusively for their ornamental iron department the buildings heretofore used by the Northey Pump Works ; the old St. Lawrence Foundry for their cast iron pipe and waterworks supplies departments, and the factory at Montreal, formerly operated by the Royal Electric Company, as a branch of their Peterboro works for manufacturing electrical apparatus. The company during the year moved into larger and more suitable premises in Halifax, Ottawa, and Vancouver.

The actual floor space used for manufacturing and office purposes, amounts to 770,000 square feet, or about 18 acres, and perhaps a better idea may be arrived at when it is stated that this is equal to a single storey building 50 feet in width by 3 miles in length.

Canadian General Electric Company Interior of Machine Shop, Montreal Works.

There are about 3,000 employees on the company's pay-roll, including office and sales staff. In 1897 the average number employed was 400, and in 1900 about 1,000.

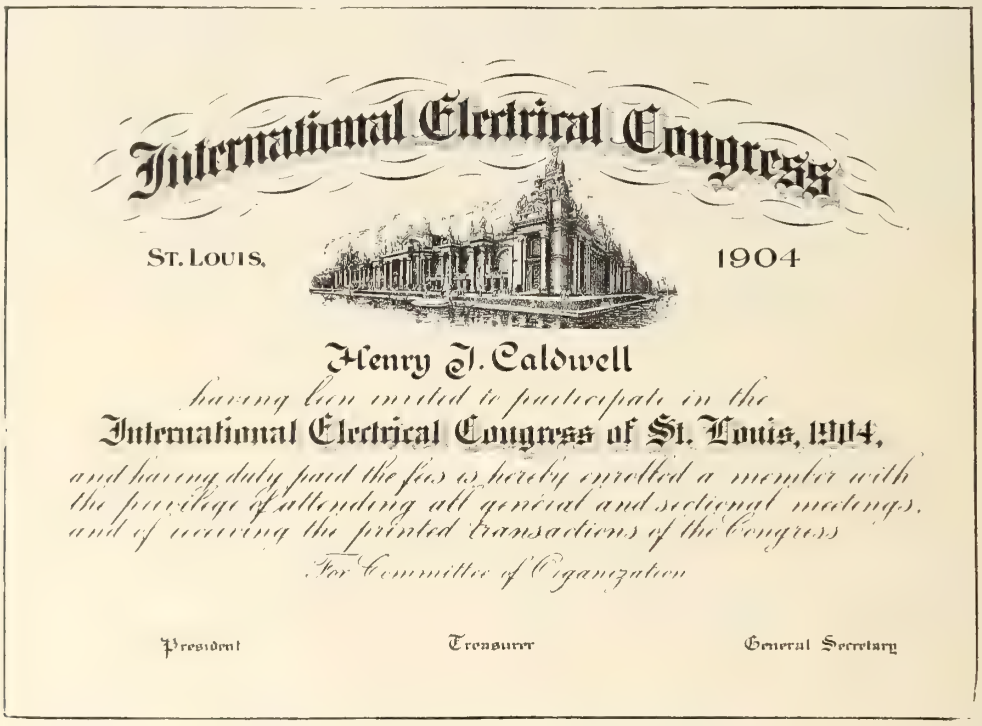
A very satisfactory feature of the year's business is the amount of unfinished contracts on hand at the beginning of the new year ; that is to say, contracts in various stages of completion but upon which no profit had been taken when the books were closed at the end of the year. In 1897 the value of contracts thus carried forward was $240,000, in 1900 it had increased to $563,000, and in January of 1904 it was $2,750,000.

In the electrical department they are manufacturing for Niagara Falls a number of the largest generators in the world, each having a capacity of twelve thousand horse-power. They are also manufacturing, under patents owned by the company, two Curtis steam turbines direct connected to electric generators each of two thousand five hundred horse-power, besides a number of smaller sizes. During the year they secured the exclusive right to manufacture in Canada the Chloride Electric Storage Battery, the Christensen Air-Brake, the Rice-Sargent Steam Engine, and several other devices of lesser importance.

In the Canada Foundry Department they have contracts for some ninety steel bridges, a number of structural steel buildings and locomotives, besides the regular output of the several departments devoted to steam pumps and hydraulic machinery, cast iron, gas and steam pipes, hydrants, valves and waterworks supplies, electric travelling cranes, machine screws, nuts, bolts, rivets, steam railway and electric railway car trucks, etc.

The Peterboro works of the Canadian General Electric Company, of which we show a bird's eye view, comprise 40 acres, including machine and erecting shop, armature shop, lamp works, blacksmith shop, brass foundry, pattern shop, boiler house, office, warehouse, stores, etc. The motive power is obtained from the company's plant at Nassau, six miles distant, the capacity of which is 1,500 horse power.

The second cut shows the interior of the main machine shop of the Montreal works, comprising upwards of 65,000 square feet of floor space devoted to the manufacture of electrical machinery.



International Electrical Congress

ST. LOUIS, 1904

Henry J. Caldwell

having been invited to participate in the

International Electrical Congress of St. Louis, 1904,

and having duly paid the fees is hereby enrolled a member with the privilege of attending all general and sectional meetings, and of receiving the printed transactions of the Congress

For Committee of Organization

President Treasurer General Secretary

INTERNATIONAL ELECTRICAL CONGRESS.

According to the present indications, the International Electrical Congress to be in session at St. Louis, September 12 to 17, 1904, will be one of the most successful that has yet been held, both with respect to the number of adhesions and to the value of the transactions.

Up to date about 3,550 circular letters of invitations to join the Congress have been issued to persons or associations in North America. From these 875 postcard acceptances of membership have been received. About 350 similar circular letters of invitation have been recently sent to other countries. It is intended to issue in all about 5,000 invitation circular letters in American and about 6,000 in foreign countries. It is expected that many persons will join the Congress, both in America and abroad, who do not expect to attend the sessions in St. Louis, in order to secure a copy of the transactions, which will form one and perhaps two large octavo volumes. Collection of fees has commenced, and upon receipt of a fee the member will be forwarded a certificate of membership, a reproduction of which is shown herewith. The certificate is 8½ inches by 11 inches in size (21.5 cms x 28 cms) and printed on heavy paper of excellent quality. A miniature replica of this certificate, without the signatures, is appended.

Recently 280 special letters of invitation have been issued on behalf of the Committe of Organization to prominent electricians and electrical engineers, requesting papers for the Congress in the various sections. Of these, 146 have been sent to foreign authors, and 134 to American authors. There has not been time to receive replies from more than a few foreign authors, but 21 acceptances have up to date been received from abroad, and 46 acceptances from North America. Sixty-seven papers are thus already promised for the Congress, and the number is steadily increasing.

Arrangements are being made with a view to perfecting plans of co-operation between the Congress and electrical societies and associations in various parts of the world. Invitations have already been extended to the Congress members to visit places of electrical interest on the journey to or from St. Louis.

The Committee of Organization of the Congress consists of Elihu Thomson, President; A. E. Kennedy, General Secretary; W. D. Weaver, Treasurer; Bion J. Arnold, Vice-President and Chairman of Executive Committee; C. F. Scott, Dr. S. W. Stratton, Prof. H. S. Carhart and Prof. W. E. Goldsbrough, Vice-Presidents.

The following section officers have been appointed by the President, and have already done much work in organizing their sections:

Section A, General Theory, Prof. E. L. Nicholls, Cornell University, and Prof. H. T. Barnes, McGill University. Section B, General Applications, C. P. Steinmetz, Schenectady, and Prof. Samuel Sheldon, Brooklyn. Section C, Electrochemistry, Prof. H. S. Carhart, Univ. of Michigan, and Carl Hering, Philadelphia. Section D, Electric Power Transmission, Mr. C. F. Scott, Pittsburg, and Dr. Louis Bell, Boston. Section E, Electric Light and Distribution, Mr. J. W Leib, Jr., New York, and Mr. G. S. Dunn, New York. Section F, Electric Transportation, Dr. Louis Duncan, Mass. Inst. of Technology, and Mr. A. H. Armstrong, Schenectady. Section G, Electric Communication, Mr. F. W. Jones, New York, and Mr. Bancroft, Cherardi, N.Y. Section H, Electrotherapeutics, Dr. W. J. Morton, New York, and Mr. W. J. Jenks, New York. All communications should be addressed to the General Secretary, Dr. A. E. Kennedy, Harvard University, Cambridge, Mass.

TELEGRAPH LINES ON VANCOUVER ISLAND.

The Dominion Government has leased to Messrs. C. H. Gibbons, of Vancouver, and D. V. Mott, of Fernie, B. C., in trust for the British Pacific Telegraph Company, for twenty-one years, the government telegraph lines of Vancouver Island. These lines were originally built about eight years ago, and have since been maintained chiefly for the purpose of affording distress shipping and seamen's facilities for communicating with owners, agents or the authorities at Victoria, and not being designed for commercial uses, have been a continuous drain on the treasury. The British Pacific Telegraph Company will aim to make the lines acquired commercially profitable, while maintaining them in such efficiency as to relieve them of their past reproach of unreliability. The company will have its headquarters at Victoria, B. C. Mr. D. V. Mott will probably become president; Mr. C. H. Gibbons, vice-president and general manager, and Mr. T. W. Patterson, M. L. A., secretary-treasurer. The company assumes possession of the lines on May 1st.

STEAM TURBINE GENERATING PLANTS.

An interesting discussion has been in progress in our English contemporary, The Electrical Engineer, in regard to the comparative efficiency of steam turbines and reciprocating engines for use in electrical generating stations.

In the number of December 25, Mr. Alfred Morcom, managing director of Belliss & Morcom, contributes a very interesting letter, in which he says, among other things, that coal and works cost for steam turbines is .78 and 1.6 as compared with .738 and 1.4 for reciprocating engines. The former figures are gathered from an average of eight exclusively steam turbine stations and the latter from data collected from 160 reciprocating engine stations. He says: "Instead of the steam turbines being, as claimed, as good as the best reciprocating engines, the figures for the turbine stations are not even up to the average of the good and bad of all sorts. These figures will, we think, appeal to an open-minded reader, as many of the 160 engine stations have old-type and uneconomical plant of various kinds."

After discussing the effect and the difficulty of securing high vacuums which add so much to the steam turbine economy, he sums up the situation as follows:

"1. For more than twenty years it has had the continuous attention of some of the best and most ingenious mechanical engineers in this country or elsewhere, but up to date the chief difficulty—viz., that in connection with the clearance—has not been solved, and is probably incapable of practical solution.

"2. The amount of the clearance premitted to obtain the results published is so small that grave practical difficulties are produced by expansion under the temperature of the working steam. Certainly this clearance can never get less during the working period, and we assert that the published figures show that it increases.

"3. To enable results to be obtained approaching those we can get from triple-expansion reciprocating engines, superheat of a considerable amount must be employed, and the clearance must be proportionately increased. It is impossible under working conditions in a station to keep the superheat within any but very wide limits, and as the clearance must be made large enough to meet the maximum superheat, waste of steam through the clearance at working temperature must be largely increased.

"4. Stripping of blades may be caused by the superheat overheating them or over-expanding the rotating part as a whole, and it may also be brought about by water or a very small foreign substance at this very high peripheral speed.

"5. The improvement in economy in the steam turbine is limited by this question of practical clearance, and there does not appear to be much chance of further improvement in view of the great care and thought which has already been expended.

"6. The one big point in connection with a steam turbine plant that appeals to everybody is the fact that the larger sizes especially can be manufactured much more cheaply than the same power of reciprocating plant, but against this must be taken into account the fact that with the steam turbines go boilers and condensing plant much larger than in the case of the reciprocating engine. Any big difference in economy or unreliability of the plant would make the difference in first cost a trivial matter compared with the trouble which might result from the change."

SUPPLY OF ELECTRIC POWER FOR CITY OF OTTAWA.

The Corporation of the city of Ottawa is asking for tenders up to March 14th for the supply of electric power for street lighting. The specifications call for a minimum of 350 electric horse power, to be ready for use not latter than May 1st, 1905, with the privilege of increasing to 600 electric horse power by giving the tenderer sixty days' notice for each additional horse power required, based on power factor of .75. The power is to be delivered in the form of four wire, two phase, alternating current, 2,200 volts, having a periodicity of 60 cycles per second. The voltage variation is not to exceed 5 per cent. in either direction, and the frequency variation three per cent.

The Corporation will install in its distributing station a receiving switchboard containing the necessary first-class standard switchboard type of indicating volt meters, ammeters and watt meters for measuring the power received. In order to prevent any misunderstanding, due to the alternating current being capable of being measured in true power or apparent power, the power shall be based, first, on a power factor of not less than .75, under which method all excess or apparent power as indicated by the volt and ampere meters shall be paid for as true power; and, second, on a price based on apparent power or volts times amperes, divided by 746, which measurement would show 75 real horse power, at a power factor of .75, to be 100 apparent horse power.

The price for power as specified above is to be based on four methods:

First. On a stipulated amount per electric horse power per year, between dusk and daylight. An electric horse power under this specification and method shall be 746 true watts. Second. On a stipulated amount per electric horse power per year, whenever required. An electric horse power under this specification and method shall be 746 true watts. Third. On a stipulated amount per electric horse power per year, between dusk and daylight. An electric horse power under this specification and method shall be 2,200 volts times amperes, divided by 746, equals horse power. Fourth. On a stipulated amount per horse power per year whenever required. An electric horse power under this specification and method shall be 2200 volts times amperes divided 746, equals horse power.

The tenderer is to submit four separate prices on each of the above four methods, as follows:

(A) A price based on five years' contract with one source of supply from tenderer's power station to the Corporation distributing station.

(B) Five years' contract with two sources of supply.

(C) Ten years' contract with one source of supply from tenderer's station to the Corporation sub-station.

(D) Ten years' contract with two sources of supply.

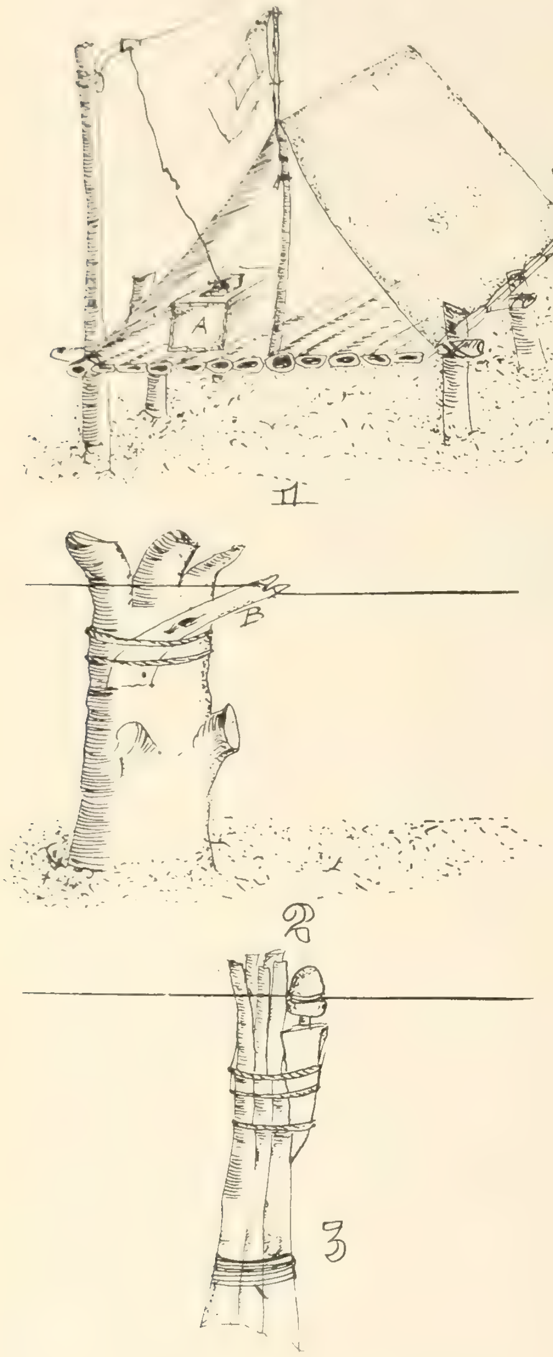
ACETYLENE GAS EXPLOSION.

The brick residence of Dr. F. R. Seager at Brigden, Ont., was wrecked by the explosion of an acetylene gas plant on February 16th. Dr. Seager escaped by jumping from an upstairs window, but Mrs. Seager and a daughter were slightly burned. The walls adjacent to the gas machine were torn away from the ground to the roof.

THE U. S. SIGNAL SERVICE IN MORO LAND.

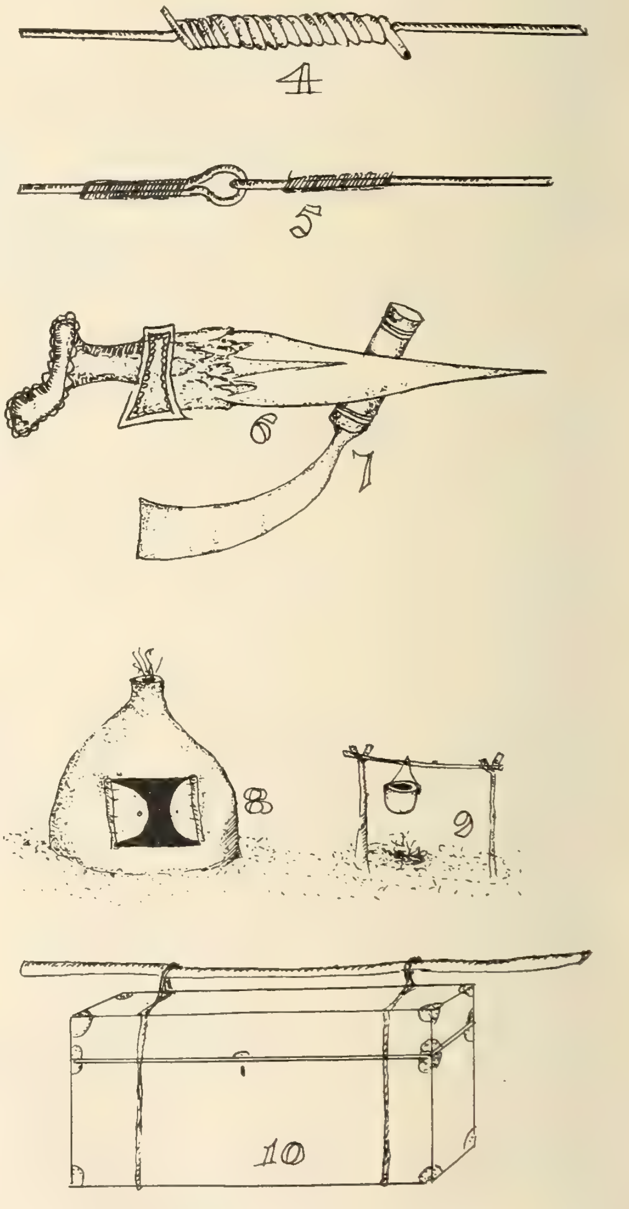
By "Signal Corp Man."

Considerable interesting and exciting information could be written about the engineers and the signal corp men of the United States Army who were engaged in the Moro campaign of 1902 on the island of Mindanoa. This island, it will be remembered, was peaceful at the time the hostilities were in progress on Luzon, Panay, and other northern islands. Early in 1902 the Moros commenced to harass the American troops, resulting in a campaign against the tribes of the interior at Lake Luno. The Lake Luno expedition was organized, consisting of a part of the 27th Infantry, the 25th Field Battery and some troops of the 15th Cavalry. The battle of Bayan was fought May 2, 1902, with heavy losses in officers and enlisted men on the American side, for Fort Pandapatan, occupied by Moro warriors with canon and rifles, had to be taken. Before this event, and during the time, as well as since, the work of the signal corp service in connection with the expedition has been remarkably effective. In all advances in the country, through the heaviest of the jungle, over trails that only natives could make headway, these linemen have established wires and instruments for the purpose of maintaining communication from the base at Malabang to all the camps. Often the system of wiring put up would be non-effective in a few days because of heavy winds blowing down trees on the wires, or because of the enemy cutting the poles and the wires.



Some Line Work in Moro Land.

The expedition was constantly shifting its position, and often times making circuitous routes, so that the signal corp men had to relay the line for many miles back. I recollect several times the trail was changed from the base, and this meant a withdrawal of guards from off the portion of abandoned trail, so that the wires were unprotected. This meant a removal of the wires to the new trail, often involving much work on the part of the signal corp men.



Devices of Moro Helpers.

SHORT OF HELP.

Because of the extent of territory covered, the signal corp service was obliged to utilize every officer and man to full capacity, owing to short-handedness. It seemed difficult, always, to secure native helpers to work on the line, and many times the operators themselves shouldered rifle and tools and went out with a small guard of infantrymen to replace poles and fractured wires. Sometimes we would find a mile of wire gone, removed by the natives. Often the natives cut the wire into small pieces. Poles were frequently chipped into shavings, to show the spite of the native, no doubt. Sometimes enormous trees were felled directly across the wires, crushing poles and all. Now and then the natives would remain in hiding near these places, and shoot into our party from behind logs, or from up on the side of a hill. This is annoying, because you cannot see anything to shoot back at. You only know that there is someone somewhere using you for a target.

Usually the soldier guard attend to these natives. But it happened several times, I remember, that two or three of us were cut off from our guard and attacked. It so happened that we secured protection in a natural barricade-like affair, and had no trouble in holding off the enemy until the guard came up, hearing the firing.

I want to tell you some things in general about the service of the signal corp man in the Isle de Mindanoa campaign of 1902, and ought to remark that he should be quite well, physically, because I recollect that for some months we used the ground and nipa shacks for homes. Shelter halves were likewise used, but it was several months before we got good tents for ourselves or for an office. Figure 1 is the office I had at Baldwin Hill, in April. Simply a shelter half which I had carried in the campaign placed in position upon a bamboo elevation, to clear the damp and muddy ground. The instrument is at A. At Vicars, where the camp was eventually established for the lake sections, we had good tents.

MAKE-SHIFT WORK COMMON.

In war times, when the main object is to get the messages through, and when one does not know how long the line is to be used in the shifting conditions, the signal corp men do not feel obliged to be very elaborate in their line work.

This idea is illustrated in Figure 2, in which is shown one of the ways used for temporary fastening a wire to a tree. A section of pronged wood is strapped or wire-nailed to the tree as shown at b, and the wire is hooked into the fork. Sometimes a little more time is expended, and some good poles made by binding up several pieces, as represented in Figure 3. This kind of a pole is substantial and elastic, because of the character of the combination of a series of thin pieces secured together as shown. The gales can swing this sort of a pole to and fro considerably without damage to the pole or wire. No nails are used. In fact, there were several weeks in which we could not get nails except some small ones knocked out of hardtack cases.

OUR HELPERS.

At the lakes, all the Moros were not unfriendly. It is true that the practice of war required every one of the opposing sides to shoot when he saw the other. Still, we often had parties of friendly Moros coming into camp with flag of truce, offering their services to work, or to sell food to the troops. Some of these fellows were engaged to work with us on the line. We selected a number of the most intelligent and tried to make assistants out of them. The next two or three drawings represent things which interested us in connection with these fellows. No matter what we instructed, the native would think out some way of his own for doing certain work, and this he would not alter. Figure 4, for example, is a sketching of one of the systems of joining ends of wire used by the natives. The idea works, of course, but requires considerable time to make the joint. Another Moro lineman form of joining ends of wire is shown in Figure 5.

WEAPONS.

The weapons of the native helpers always caused interest in camp whenever we entered. Figure 6 is one of the weapons carried by the native linemen as a weapon of defence. He will not insult this fine weapon by chopping wood with it. This weapon is kept in a case secured to the belt. The edge is keen and the blade well polished. The handle is usually set with ornaments of rare descriptions and oftentimes the knife represents considerable value. Attached also to his belt is the work knife, Figure 7, which is also keen and shiny, but is calculated for cutting poles and doing general work on the line. Soldiers consider these weapons as good relics and the natives have many offers for their weapons.

We always found the Moro helpers to be useful in getting up shacks for us for camping for the night, for throwing up earth ovens like that in Figure 8 for cooking, and also for boiling our water as in Figure 9. The conditions of climate and fevers, etc., in the tropics, require that drinking water be boiled, and this is quite a problem in camp.

In Figure 10 is a drawing of the manner in which our helpers would pack our truck. We had to carry tools, wire, and often instruments on the trails without animals and were compelled to hire native carriers, who would adjust a pole, as in the cut, and place this pole on their shoulders and carry the package at a trot for miles, up grade and down grade, fording rivers and rapids, and crossing narrow bamboo poles for bridges. In case of attacks, the natives were in the way, for they would try to get behind us, until we had the enemy running, then they would come out bravely enough. I shall never forget my Moro campaign experience and would not have missed it for worlds.

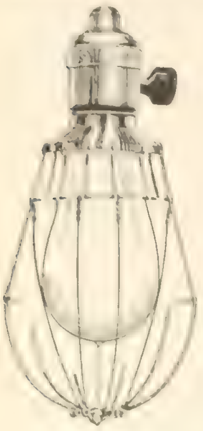
BELL TELEPHONE COMPANY ANNUAL MEETING.

The annual meeting of the Bell Telephone Company was held in Montreal on February 25th, at which the announcement was made that there would shortly be an addition of $2,000,000 to the capital stock, the same being rendered necessary by the rapid development of the system, which called for the building of new lines and the construction of additional buildings.

Incorporated in the annual report were the following facts relative to the growth of the company during the year 1903: The number of subscribers added during the year was 8,691. The total number of instruments now earning rental is 57,172. The company now owns and operates 421 exchanges and 672 agencies. 4,121 miles of wire were added to the Long Distance system in 1903; of these 1,738 are in the Ontario department, 1,260 in the Eastern department, and 1,123 in the North-Western department. The long distance lines now opened and operated by the company comprise 30,969 miles of wire on 7,685 miles of poles.

The financial report showed receipts of $2,522,275.11, expenses $1,940,123.32, leaving a net revenue of $582,151.79. Dividends paid (including January 15th, 1904) called for $467,510.35. After carrying considerable sums to the insurance and accident reserve accounts and to the contingent fund, there was carried forward a balance of $40,536.13. The report was adopted and the old board of directors re-elected, as follows: C. F. Sise, president; Hon. Robert McKay, vice-president; E. P. Fish, Robt. Archer, Wm. R. Driver, Hugh Patton, Charles Cassils, Thos. Sherwin.

NEW STYLE LAMP GUARD.



Owing to the excessive breakage on incandescent lamps and the need of a strong lamp guard to prevent this breakage, The R. E. T. Pringle Company, Limited, have recently placed on the market the "Greenwood" Superior Multiple Guard, which is shown in the accompanying cut. This guard is strongly made, and has a series of yielding guard wires arranged longitudinally, each engaging the bulb as shown in the cut. These guard wires are made with springs at the top which adjust themselves very readily to any style or size of bulb, and prevents the breakage caused by the bulb striking the guard. It is very simple in construction and can be applied or removed very easily, and without the aid of tools or removing the incandescent lamp, which is a point which nearly everyone would appreciate who have used the old style of lamp guards. It is made to last and give protection, and should be appreciated by the trade.

This guard is sold by the R. E. T. Pringle Company, Limited, of Montreal, who have branch offices in St. John, N.B., and Toronto, Ont.

TRADE NOTES.

Mr. H. Holt has resigned his position as the manager of the plant and motor department at Messrs. Veritys, Limited, London, and taken up a similar position with the Rhodes Electrical Manufacturing Company at 70 Bishopsgate Street Within, London, E. C.

The Pittsburg Transformer Company, Pittsburg, Pa., announce in their advertising pages that they have finally decided to do away with intermediate agents in selling their goods in Canada. Their reasons are well set forth in their announcement, which is rendered attractive by the head which appears also on their March issue of the Pretty Girl Calendar. The company state that their intention is to give the customer the benefit of the commission usually allowed to agents. This will to a great extent overcome the drawback of the duty levied on transformers and should enable their customers in Canada to secure these transformers at very attractive prices.

Messrs. C. W. Bongard & Company have recently sent out notices of their new address, 52 Adelaide St. West, Toronto. It is interesting to note that this business, which was established some three years ago by Mr. Bongard to represent Hart's famous "Diamond H" line of switches, etc., has grown rapidly, owing to energetic canvassing and prompt attention for which this company is now noted. They intend to carry a complete stock of the following high grade specialties:--"Diamond H" Switches and Wall Appliances, Bossert Panel Boards and Conduit Boxes, Alphaduct Flexible Conduit, Iron Armored ConduitL, orciated, International Dead-Beat Meters, Norton Direct Current Meters, Wire and Cables. They have gained the confidence of the electrical trade by handling only high grade and New Code specialties.

PUBLICATIONS.

The Jenckes Machine Company, of Sherbrooke, Que., have issued a neat catalogue referring to the Farrel patent ore and rock crusher. In the front of the catalogue is shown a splendid bird's-eye view of the works of the company.

Circular No. 1061, by the Westinghouse Electric & Manufacturing Company, contains illustrations and general information regarding autombile charging outfits, while Folder No. 4006 refers to auxiliary apparatus for railway equipment.

The Feburary number of The Jones Magazine, published by the Underfeed Stoker Company, contains interesting illustrations showing stokers in operation under Scotch and Babcock & Wilcox boilers in the plant of the Toronto Railway Company.

Messrs. Fogarty Bros., electrical contractors and engineers, Montreal, are sending to their present and prospective customers an attractive catalogue designated "Electrical Specialities." This company are Canadian representatives of the Dow Portable Electric Company, of Boston, Mass.

"Municipal Ownership at Fort William" is the title of a pamphlet issued by Mr. C.H. Jackson, Mayor of that town, in reply to the statements made by the Special Commissioner of the Ottawa Free Press regarding the operation of the electric light, telephone street railway and waterworks systems in Fort William.

About the handsomest line of advertising which reaches this office is that which is sent us the first of each month by the Pittsburg Transformer Company, Pittsburg, Pa. This advertising is in the form of monthly calendars accompanied by a circular or leaflet containing illustrations and talk on the product of this well known company. Many of these illustrations, we are informed, are published for the first time in these circulars and thus the company is able to present its friends and customers immediately with illustrations of its new styles and other new features as rapidly as these are brought out. The calendars themselves are as dainty and attractive as they well could be, and the company wish us to state that if anybody interested in electric matters is not receiving these each month, they will be very glad to add his name to their mailing list.

"ANYUN" HIGH VOLTAGE OIL FUSES
500 to 50,000 Volts

Thoroughly Tested
Absolutely Efficient
Positively Non-arcing
Neat, Durable, Economical and Reliable
An absolute guarantee against destruction of switchboards
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The HILL ELECTRIC SWITCH CO., Limited
Sole Agents for Canada and Newfoundland
426 ST. PAUL STREET, MONTREAL

PERSONAL.

Mr. Howard Wright, son of Mr. A. A. Wright, M.P., Renfrew, Ont., has been appointed manager of the Pretrolia Electric Light Company.

Mr. Chas. Brandeis, consulting engineer, of Montreal, recently returned from a two months' trip to England and Germany, made in connection with some large electric lighting and railway plants in China. While in Europe he took occasion to make a study of high speed electric railways.

Mr. Wm. Thompson, author of the Canadian Hand-Book of Steam and Electricity, who for four or five years past has been manager and consulting engineer for an English syndicate owning mines at Rossland, B.C., Mexico and elsewhere, was a visitor to the recent Mining Convention in Toronto.

Mr. Ludger Trudeau has been appointed superintendent of the Montreal Street Railway. Mr. Trudeau is an old employee of the Montreal Company. After managing the car service at Bordeaux, France, for two years, he went to Egypt last June to take charge of the Alexandria Tramway System and the Alexandria & Ramleh Railway Company, Limited.

Mr. Robert Turnbull, who has just been appointed to the position of mechanical and electrical engineer of the Northern Ohio Traction & Light Company, of Akron, Ohio, is an old Galt boy. He learned his trade in the shops of the Goldie & McCulloch Company and became foreman in the machine department. Two years ago he accepted a position with the Traction & Light Company, and his promotion to the office of chief engineer is very gratifying to his many Canadian friends.

There died in Montreal on February 24th Mr. Jesse Joseph, who for upwards of half a century was a prominent business man of that city. Although he had reached the advanced age of eighty-seven years, he was down town two days prior to his death. Mr. Joseph was for many years president of the Montreal Gas Company and the old City Passenger Railway Company, and it was during his administration that the double tracks and loop lines were introduced on the street railway. He resigned as president in 1892, being succeeded by Mr. James Ross, under whose direction the old company ceased to exist and the present street railway company rose in its stead. Mr. Joseph was also one of the founders of the old Montreal Telegraph Company and of the Peoples' Telegraph Company and at one time a member of the board of the Dominion Telegraph Company. He became very wealthy.

SPARKS.

The Laval Electric Company, of Montreal, has been granted incorporation.

The DeWitt Electrical Company have established their headquarters at Truro, N. S. Mr. S. C. DeWitt is manager of the company.

As the result of an agreement recently reached between the company and the Council of Toronto Township, the Toronto & Mimico Electric Railway Company will this spring extend their road to Lorne Park, a distance of six miles.

The Toronto & Niagara Power Company propose to use steel poles at distances of four hundred feet to carry their transmission lines from Niagara Falls to Toronto. There will be four lines of 10,000 horse power each.

Mr. J.M. Campbell, of the Gananoque Electric Light Company, has purchased the valuable water power at Kingston Mills. He is now negotiating for a franchise to distribute electric power in the City of Kingston, and if successful will likely install an electric plant for power purposes.

The City Council of New Westminster, B.C., have passed a motion agreeing to accept the offer of the Vancouver Power Company to furnish electric power for street and house lighting at two-thirds the present cost to the city as generated by its own plant. The Light Committee ascertained that the city generated power at a cost of 2.2 per kilowatt hour, and the price paid to the Vancouver Power Company will be about 1.46 cent. This offer is made, it is said, in consideration of assistance given the company in securing water privileges at Lake Coquitlam.

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AND OTHER ELECTRICAL SPECIALTIES

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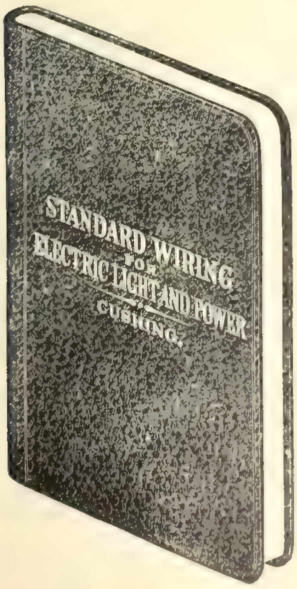
Complete stock carried at our New York Office, 136 Liberty St.



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It is the only book on Wiring and Construction kept strictly up to date.
It contains all the necessary Tables, Rules, Formulas and Illustrations.
It settles disputes, and if referred to before wiring will prevent disputes.

Flexible Leather Cover, Pocket Size, Retail Price - - $1.00 Each

Address orders to Canadian Electrical News, Toronto, Can.

SPARKS.

The residents of Janeville, Que., are now furnished with electric light by the Ottawa Electric Company.

The Miller Tanning Extract Company, of Millerton, N. B., have placed an order for an electric plant for lighting their works.

The Poplar Power and Light Company, Limited, has been incorporated by the British Columbia Government, with a capital of $15,000.

A number of influential business men of Blackville, N. B., are endeavoring to form a company for the purpose of having the village lighted by electricity.

The work of stringing the wires on the power line extension of the Cascade Water, Power & Light Company from Phœnix to Greenwood, B. C., is now well advanced.

Messrs. E. W. Tobin, of Brompton Falls, Que., and F. N. McCrea, of Sherbrooke, have purchased the water power of the St. Francis Falls, opposite Kingsey, Que., and will likely install an electric plant.

The Toronto & Suburban Railway Company have been compelled, in view of the requirements of the company for more power, to cancel the supply of current to private consumers in Weston and Toronto Junction.

The Cataract Power Company, of Hamilton, have notified their customers that after the present contracts expire they will not supply power to operate direct current motors. Alternating current motors only will be used.

Mr. John G. Stevens, jr., of Stephen, N. B., has applied to the Dominion Parliament for an Act to extend the time for the commencement of the proposed operations of the Sprague Falls Manufacturing Company, Limited.

Mr. George Waller, manager of the Hamilton, Grimsby & Beamsville Electric Railway Company, recently returned from New York, where he is said to have closed contracts for several 50 horse power motors for car equipments.

Incorporation has been granted to the Q. & C. Bonzana Rail Joint Company of Canada, Limited, of Montreal, with a capital stock of $20,000. It is proposed to manufacture appliances for use in connection with steam or electric railways. The promoters include Messrs. James W. Woods, merchant, of Ottawa, and Norman J. Holden, merchant, of Montreal.

Mr. J. J. Hill and associates are said to have obtained control of the franchise to develop the power of Stave Lake and Stave River in British Columbia. It is said that it is proposed to use this power for the operation of a railway between New Westminster and also on the branch road from Cloverdale to Port Guichon. Contracts are to be let shortly for the foundation work and penstocks to be built at Stave River, it being the asserted intention to have electric power delivered in Vancouver by the end of the present year.

NEW TELEPHONE LINE

A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates :

Port Rowan -	50c.
St. Williams - -	50c.
Vittoria - -	40c.

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We are the Originators of the System of

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Electric Companies By installing our underground system of steam heating can pay their entire station expenses and interest on the steam investment

More than 250 such plants in successful operation.
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We contract for the construction of the steam mains complete.
Our work is the best. We have the only METER SYSTEM in use.
Our expansion devices and our installation are the most effective.

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AMERICAN DISTRICT STEAM CO.
LOCKPORT, N.Y

SPARKS.

Messrs. A. & R. Loggie, of Loggieville, N. B., have placed an order for a 600-light plant for that town.

Mr. W. F. VanBuskirk, City Engineer of Rossland, B. C., is said to be preparing plans for a civic lighting plant to be installed there.

Since the plant of the Coaticook Electric Light Company was purchased by the corporation, the municipal council has had considerable trouble. Recently a portion of the dam was carried away by a freshet.

The engineering students at McGill University who intend to to specialize in this class of work, are now engaged in the construction of an automobile. The machine, when completed, will be upholstered in scarlet and white, the colors of the University. The motor is of 12 horse power and has two cylinders of four and a half inches diameter and with a stroke of five inches. The average speed of the revolutions per minute is 750, with a maximum of 1,200. Gasoline will be the fuel used, and the jump spark ignitor will be employed. A 1,800 pound car will be the capacity of the motor, and the speed is excepted to reach thirty miles an hour.

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ELECTRIC ENGINEERING AND SUPPLY COMPANY.

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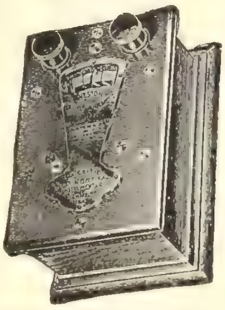

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VOLTAMMETERS, AMMETERS,
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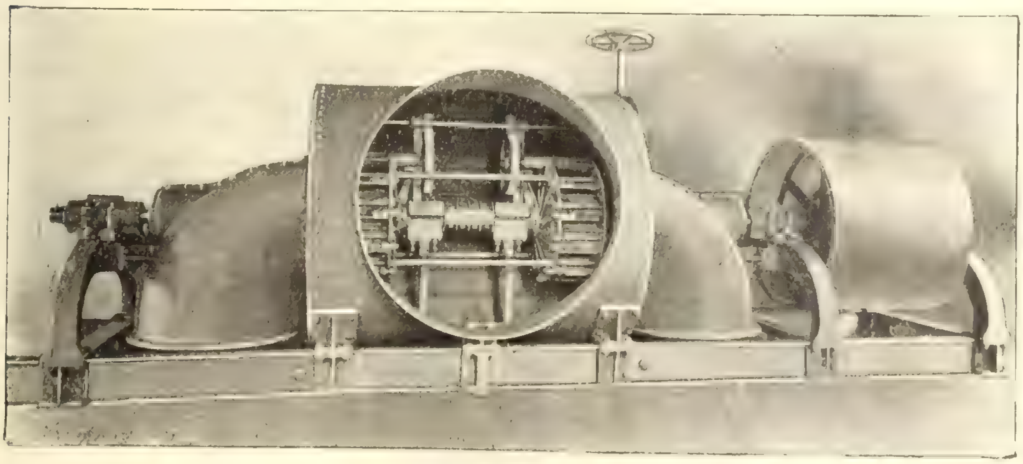
Our Portable Instruments are recognized as THE STANDARD the world over Our STATION AMMETERS and VOLTMETERS are unsurpassed in point of extreme accuracy and lowest consumption of energy.



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SPARKS.

The corporation of Weston, Ont., have installed a new C. G. E. dynamo in their power house.

The Arnprior Electric Light Company, of Arnprior, Ont., have installed a new dynamo in their power house.

The Sarnia Street Railway Company have just installed a large C. G. E. generator. The present generator will be kept as a reserve.

The City Council of Sherbrooke, Que., at a meeting held on February 10th, decided to give the Sherbrooke Light, Heat & Power Company $233,000 for their electric light and gas plants. A by-law to raise the money will be submitted to the ratepavers at an early date.

Concerning the reported intention of the Ottawa & New York Railway Company to change their motive power from steam to electricity, Mr. Henry W. Gays, general manager, writes to the ELECTRICAL NEWS as follows: "At the present time we are looking into the cost of the proposed change. Until we have that matter well in hand we are not in a position to give further information, as the cost of the change will be one of the elements which must be considered."

SPARKS.

The City of St. Catharines, Ont., has a bill now before the Ontario Legislature for power to apply $150,000 raised for the development of water power at DeCew Falls to the construction of a high level bridge and the purchase of stock in an electric railway.

The Town Council of Parry Sound, Ont., have given a contract to the Canadian General Electric Company to install a pump and motor for waterworks purposes. The pump will have a capacity of 600 gallons per minute and the motor will be 58 horse power. The cost will be $4,324.

The Council of Windsor Mills, Que., have fixed the following schedule of prices for 16 candle-power lamps: 1 lamp, $4; 2, $7.55; 3, $10.65; 4, $14; 5, $17.25; 6, $20.40; 7, $23.45; 8, $26.40; 9, $29.25; 10, $32. All lamps above 10, $2.75 each per annum. No light supplied under yearly return of $12.

A lecture on "Interior Electric Wiring" was recently delivered by Prof. R. B. Owens, of McGill University, before the Insurance Institute of Montreal. Prof. Owens stated that there were three primary considerations to be observed: First, the conductor system must be of ample current carrying capacity in order that there might be no risk of overheating with consequent danger of fire; second, the conductor must be insulated so as to render it harmless and also to prevent any leakage of the current with further risk of fire; third, all the best known current regulating and pressure limiting devices should be installed on the circuit. The audience was conducted to the Engineering building, where some interesting experiments were made showing the tensile strength of iron and the pressure resisting power of wood.

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SPARKS.

The Fundy Coal Company are installing the latest improved mining machinery at Lower Cove, N.S. The coal-cutting machinery and hauling apparatus will be operated by electricity.

The directors of the Montreal Street Railway Company have appropriated $300,000 to be used in the construction of fifty new cars, which will be built in the company's own shops. These cars will be convertible and will be forty feet over all, the car body itself being thirty feet. The entrance door will be at the side, taking the room occupied by the end of the seat in the present cars. It is expected that the cars will cost an average of $6,000 each.

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RAILWAY FEEDERS and TRANSMISSION LINES...
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Prices with full information on application.
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as illustrated is a handsome instrument, perfect in construction and design, with no exposed contacts or wires, and has many other points of advantage.

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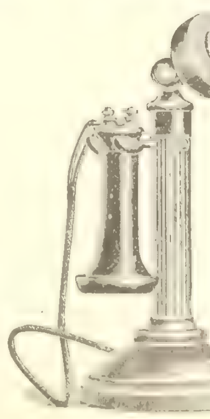

SPARKS.

The town of Orillia, Ont., is to furnish electric power for the Canada Linen Works Company at $16 per horse power per annum.

The Toronto Suburban Railway Company has applied to the Ontario Legislature for permission to extend their electric railway to Niagara Falls, with branches to Woodbridge and Brampton.

Mr. W. H. Grant, manager of construction, is asking for tenders by March 15th for the construction of a telegraph line between Mahone and Halifax, about seventy miles, and between Bridgewater and Liverpool, about thirty miles, on the line of the Halifax and Southwestern Railway.

The Ontario Electric Railway Company, which proposes to build an electric railway between the cities of Toronto and Kingston, have issued the prospectus. The capital stock is $5,000,000, the amount to be issued being $2,250,000. A similar amount is to be held for the extension of the system. The estimated receipts of the proposed road are $624,517.80, operating expenses $281,033.01, and after allowing for interest on bonds, and 6 per cent. dividend on stock, a surplus of $38,489.79 is estimated.

Clarkson School of Technology Thos. S. Clarkson Memorial, Potsdam, N.Y.

Courses leading to degrees of Bachelor of Science in Civil, Electrical and Mechanical Engineering, comprising four years of thorough training and resident collegiate work in theory and practise of engineering. Well equipped shops, aboratories, drafting rooms and power plant. Located near Massena and the engineering developments along the St. Lawrence River. Healthful climate. Tuition moderate.

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Electrical and Mechanical Engineer, 27, with college training and 6 years' practical experience in designing and carrying out electrical plant, with leading firms, wants engagement. Address "Engineer," care Street's, 30 Cornhill, London, England.

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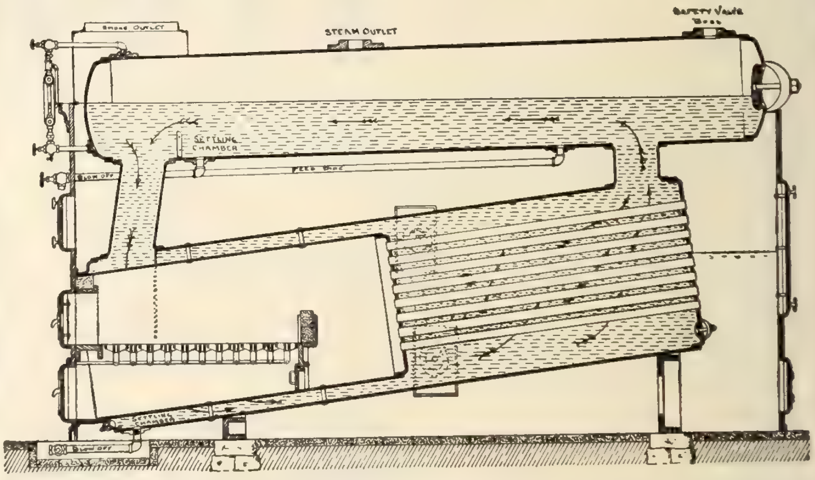

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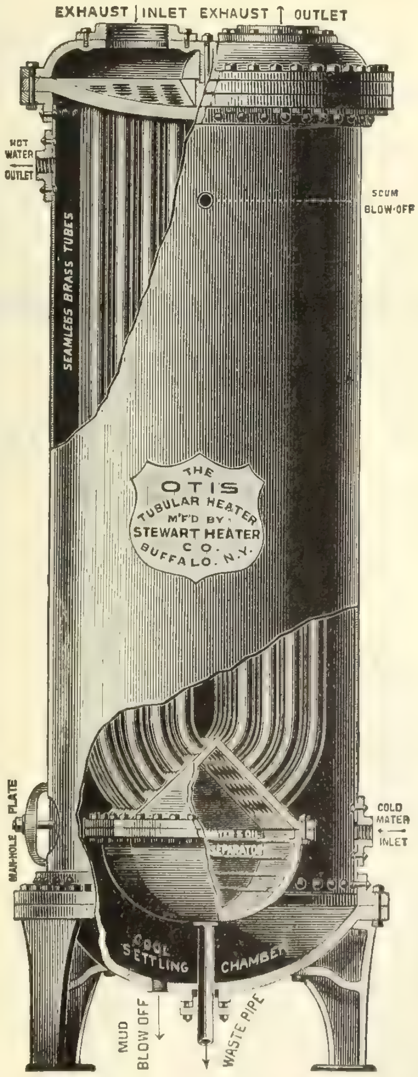

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SPARKS.

The Minister of Marine for Canada will take steps next spring to light the St. Lawrence channel between St. Francis and Quebec. This will leave a fifty mile gap between Sorel and St. Francis to be lighted in the season of 1905.

The Canadian General Electric Company are installing a new electric light plant in the Intercolonial Railway yards at Moncton, N.B. The generators operate at 2,300 volts and are driven by Robb-Armstrong engines. They are installed in a new brick power house 160 × 50 feet.

ELECTRICAL & TRANSFORMER SHEETS, STRIPS & STAMPINGS
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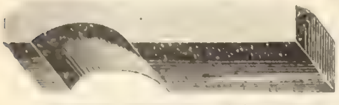

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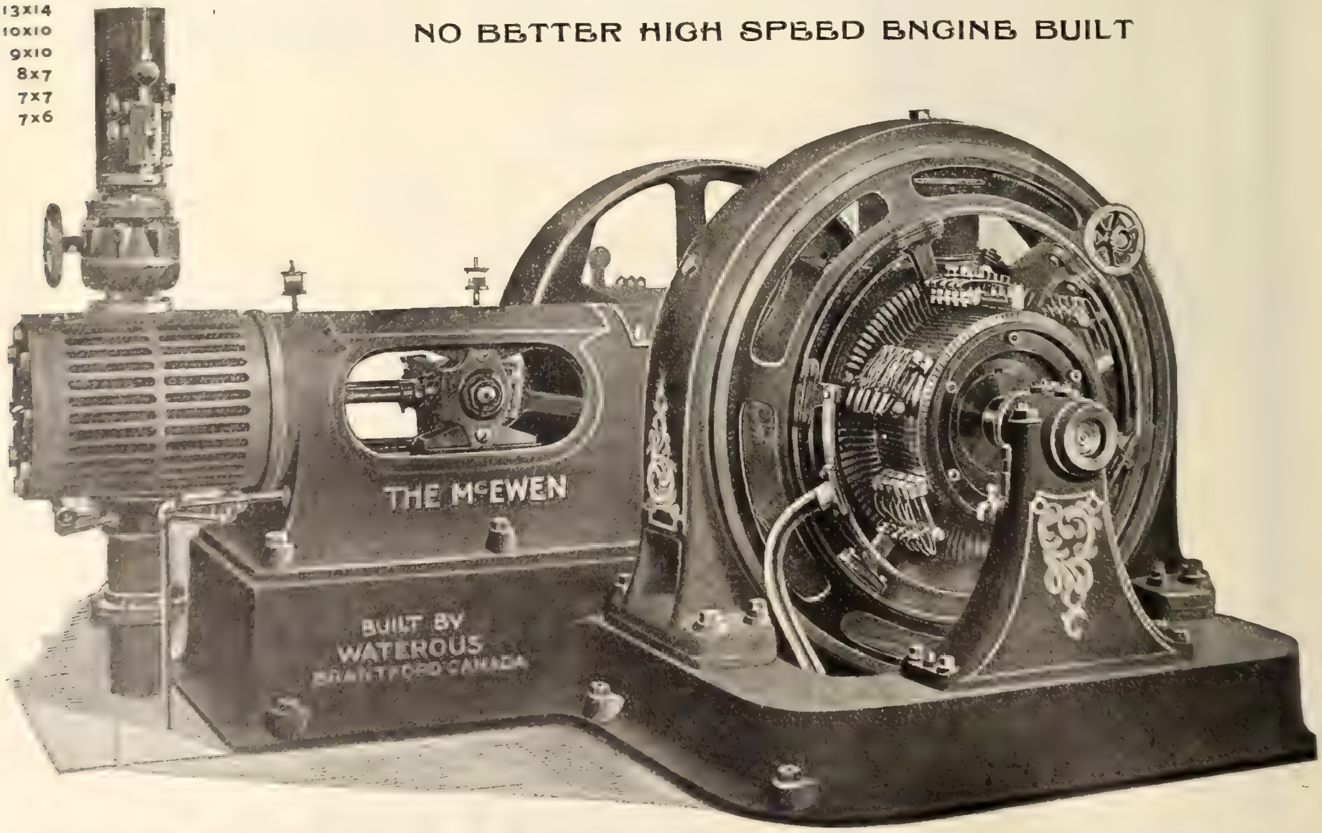

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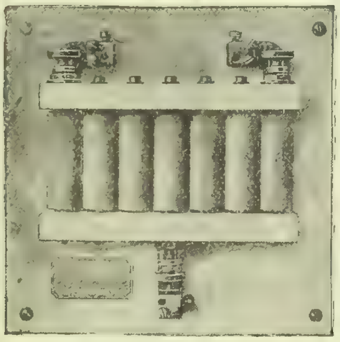

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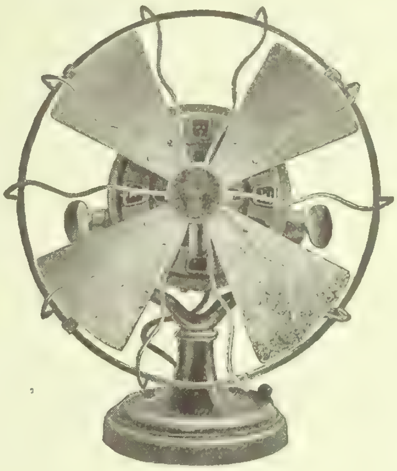
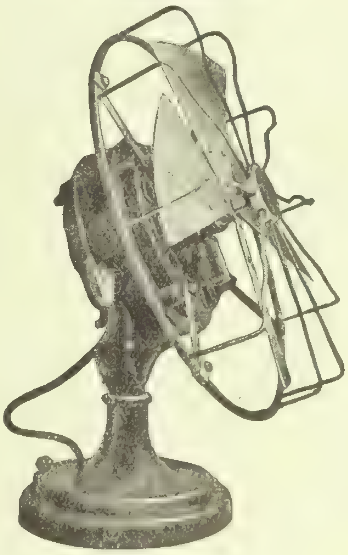
Season 1904





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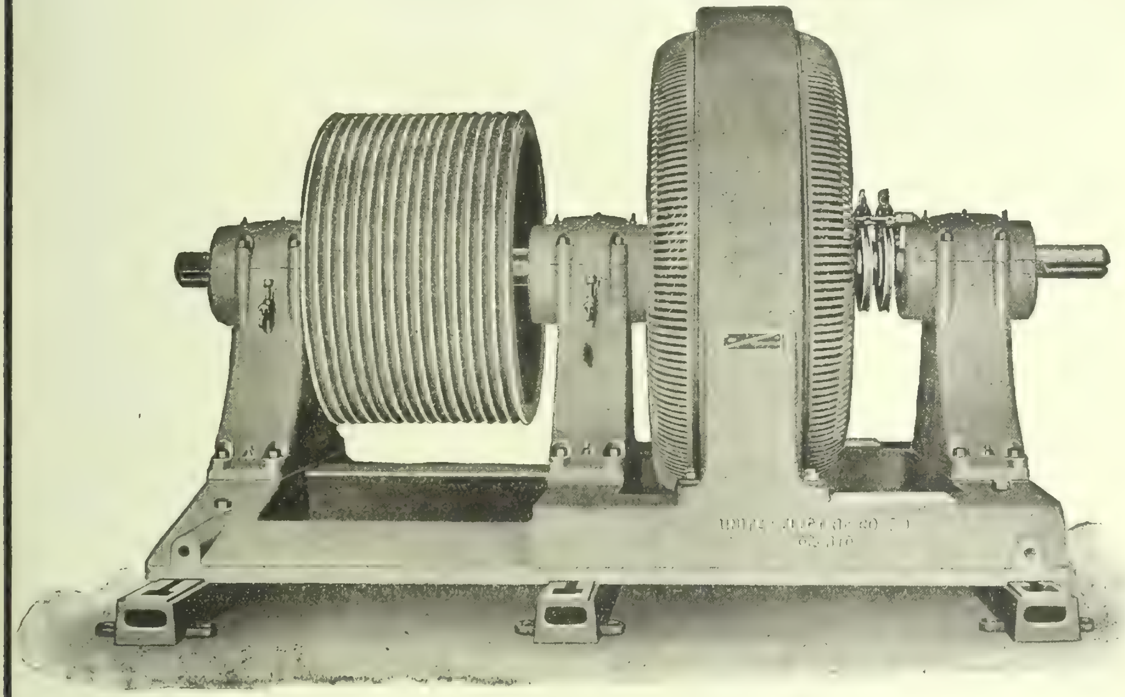

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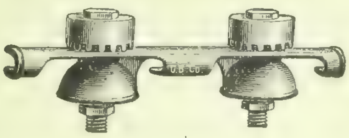
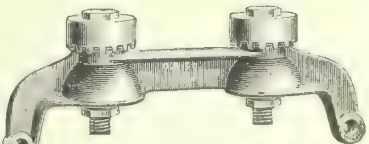
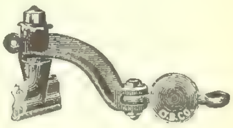
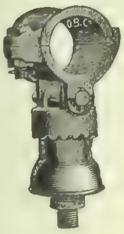
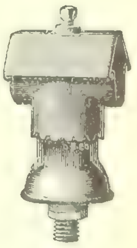

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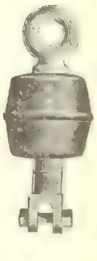

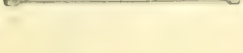

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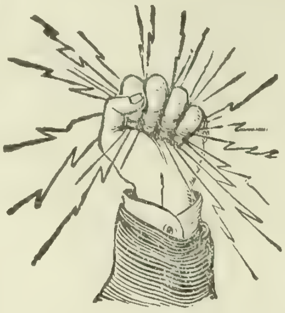

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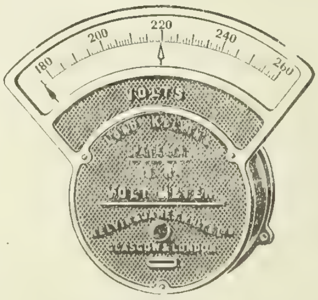

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MANUFACTURERS OF
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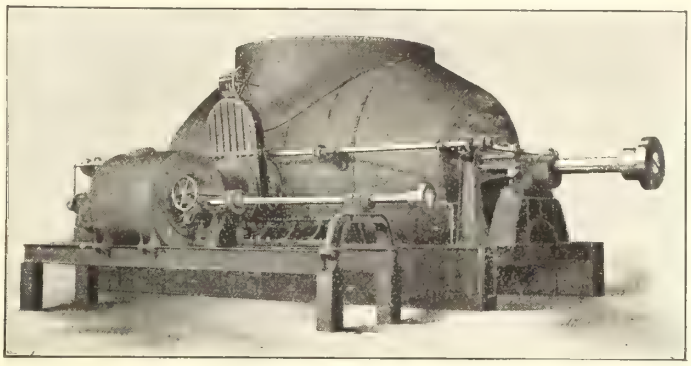

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Write for catalogue if contemplating purchase of Turbines.

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Telegrams: RHODI QUE., LONDON

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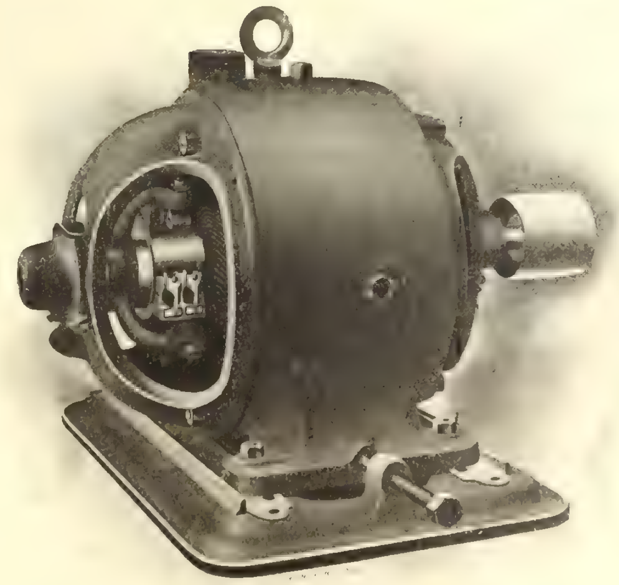

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Works: BRADFORD

TRADE NOTES.

The William Kennedy & Sons Company, of Owen Sound, Ont., have just supplied a turbine of 2,750 horse power capacity to the Ottawa & Hull Power Company.

The Packard Electric Company, of St. Catharines, Ont., report a large demand for their "Skedoodle" sign lamp, which retails at $1.25 for a 16 c. p. lamp. It is claimed to be the ideal lamp for signs and show window displays.

The Crow's Nest Pass Coal Company has ordered from the Robb Engineering Company two 175 horse-power Robb-Mumford boilers for their mines at Fernie, British Columbia, in addition to three of the same style installed last year.

The Crocker-Wheeler Co., manufacturers and electrical engineers, of Ampere, N.J., announce that their capital stock has been doubled, and now stands at $2,000,000. The company have now fifteen branch offices in the United States.

The Robb Engineering Company has received an order from J. G. White & Co., of London, England, for a 300 horse power Robb-Armstrong tandem compound engine, to be a duplicate of two engines supplied by them for the Perth Tramways, Western Australia, five years ago.

Mr. G. W. Hart, of the Hart Mfg. Co., Hartford, Conn., makers of well-known electrical specialties, visited Toronto recently to confer with Mr. C. W. Bongard, Canadian representative. The announcement of this company will be found on page vii of this and succeeding issues of the ELECTRICAL NEWS. Their goods are strictly high-grade.

Attention is called to the announcement in this number of the Volta Electric Repair Works, recently established at No. 86 Adelaide street west, Toronto. Mr. D. McGregor Johnston, the proprietor, is a graduate of the School of Practical Science, and from an experience of twelve years, is thoroughly familiar with the construction of electrical machinery for both D.C. and A.C. systems.

Mr. E. F. Clarke presented a petition in the Dominion Parliament from Hon. Chas. Algernon Parsons, asking that his rights on the Canadian patent for the Parsons turbine shall not be forfeited by failure to manufacture in Canada within the specified time. He states that a steam vessel designed to be fitted with turbine machinery of about 3,000 horse power is being constructed in England to ply during the summer of 1904 on Lake Ontario and other inland waters; also that arrangements are now being made with the view of manufacturing in this country.

SPARKS.

A propisition is reported to be on foot to build an electric railway from Midway, B.C., to Cheesaw, Wash., a distance of about twenty miles.

The by-law submitted to the ratepayers of Kingston, Ont., for the purchase of the lighting plant was carried by an overwhelming majority, the vote being 1,397 for and 37 against.

Mr. George C. Abernathy, a consulting engineer of New York, recently made an inspection of a water wower at Lac du Bonnet, Man., in the interest of New York capitalists.

The Canadian General Electric Company are transferring a portion of their machinery in their Montreal shops to Peterboro with the object of concentrating the manufacture of certain apparatus at one point.

Mr. R. Burtchart, of Owen Sound, Ont., is endeavoring to form a company for the purpose of establishing cement works at Saanich Arm, Vancouver Island, B.C. He proposes to obtain the necessary power from Sooke Lake, eleven miles distant.

Mr. A. E. Welsh, managing director of South-Western Traction Company, returned recently from London, England, and states that arrangements have been made with an English syndicate for floating the bonds of the company. This will assure the carrying out of the enterprise, which includes the building of an electric railway connecting Hamilton, London, Brantford, Woodstock, St. Thomas, Port Stanley, and other points in western Ontario. Under the terms of the agreement, the road is to be built south to Port Stanley and west to Delaware the first year, and to be continued from year to year in blocks of not less than thirty miles until completed.

ANNOUNCEMENT

The Dodge Manufacturing Co. of Toronto, Limited, beg to announce to their many friends and customers in Eastern Canada that they have opened up a

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for the more ready distribution of their Standard Lines of Transmission Machinery in the East.

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Used by the Largest Central Stations in Canada

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Send your name for our mailing list, we have some good news for you. . . . .

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General Offices: McKinnon Building, TORONTO
Factory at St. Catharines.

SPARKS.

Mr. Chas. Brandeis, C.E., of Montreal, is looking into the possibilities of an electric railway at Brandon, Man.

The Waterloo Electric Light Company, Waterloo, Ont., will on July 1st next change from the flat rate to the meter system.

The Water Commissioners of Windsor, Ont., will ask for tenders for installing an electric plant at the pumping station.

The St. Thomas Gas & Electric Light Company, St. Thomas, Ont., will increase their capital stock for the purpose of extending their plant.

It is probable that the Grand Trunk Railway will install an electric plant in their new machine shops at Barrie, Ont., for lighting their shops and yards there.

The City Council of St. Thomas, Ont., have appointed a committee to ascertain from the St. Thomas Gas & Electric Company the price at which they would be willing to sell their plant to the city.

The Shawinigan Water & Power Company have announced that they will construct a second transmission line from Shawinigan Falls to Montreal, capable of transmitting 10,000 horse power.

The Rat River Power Company is being organized at Emerson, Man. The promoters expect to be in a position shortly to begin the construction of a power dam with a view to the generation of electricity.

The corporation of Fenelon Falls, Ont., have commenced work on a new power house, which will be 32x40 feet and two stories high, with concrete walls. The generator to be installed will be 600 horse power.

The American Motor Car Company, Limited, has been organized at Berlin, Ont., to manufacture motor cars and vehicles of a similiar character. The directors include Messrs. Milton Good and Isaac Neuber.

The largest searchlight in the world will be seen at the World's Fair. It was recently finished in an electric plant at Lowell, Mass. It weighs nearly four tons, is of 5,250,000 candle power and projects a beam of light seven feet in diameter.

It is proposed to commence work at once on the construction of an electric railway for Edmonton, N.W.T., and to that end Mr. T. A. Stephens has invited tenders for the delivery of 20,000 ties and 1,000 poles. The franchise is held by Mr. W. T. Tretheway, of Montreal.

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SPARKS.

Mr. George Westinghouse, jr., has recently taken out several patents on a new type of steam turbine.

The Martin Electric Supply & Construction Company, St.-Catharines, Ont., has been incorporated, with a capital of $40,000, to acquire the business of the Martin Electric Supply Co.

The City Electrician of Victoria, B.C., has recommended the installation of another dynamo of 100 lights capacity, which, with forty extra lamps, driving pulley and belt, would cost approximately $5,000.

Mr. J. W. St. John has introduced a bill in the Ontario Legislature to regulate the overcrowding of street railway cars, and which provides that every passenger shall be entitled to a seat. Should the cars be so overcrowded as to prevent each passenger having a seat, then the passenger not receiving his proper seat shall be entitled, if a ticket-holder, to tear his ticket in two parts and use one part for that trip, and the other part of the ticket shall be good for a standing trip at any future time when the cars shall be so overcrowded that he shall be unable to receive his proper seat. It is intended that the Act shall apply to railways in cities.

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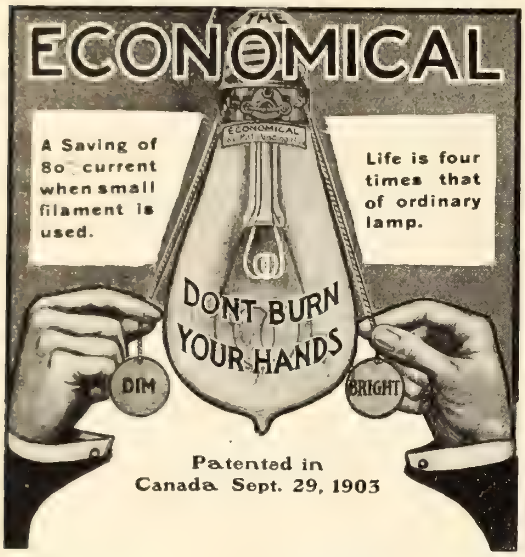
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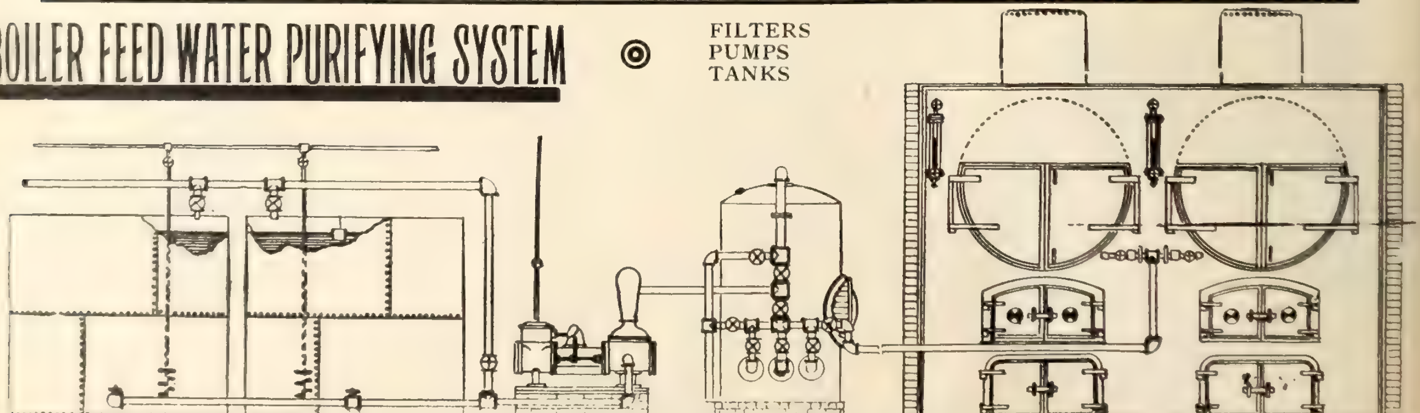

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CANADIAN
ELECTRICAL NEWS
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VOL. XIV. APRIL, 1904 No. 4.

WATER POWER TRANSMISSION PLANT AT ELLIOTTS FALLS, ONTARIO.

By CHARLES L. FITCH.

Among the more recent enterprises set on foot in Ontario, not the least important is the cement works of the Raven Lake Portland Cement Company, a six-kiln plant of modern design located at Raven Lake, in Victoria County, about eighty miles north of Toronto on the Grand Trunk Railway. This manufactory, which will be ready for operation early in the coming summer, was designed by the well-known cement engineer, Robert F. Wentz, of Nazareth, Pa., and represents the most advanced ideas in the economic manufacture of cement. The marl forming one of the ingredients is to be dredged from the bottom of the lake, which covers a deposit of great depth, and the clay to make the mix will be brought in by rail from one of the near-by beds.

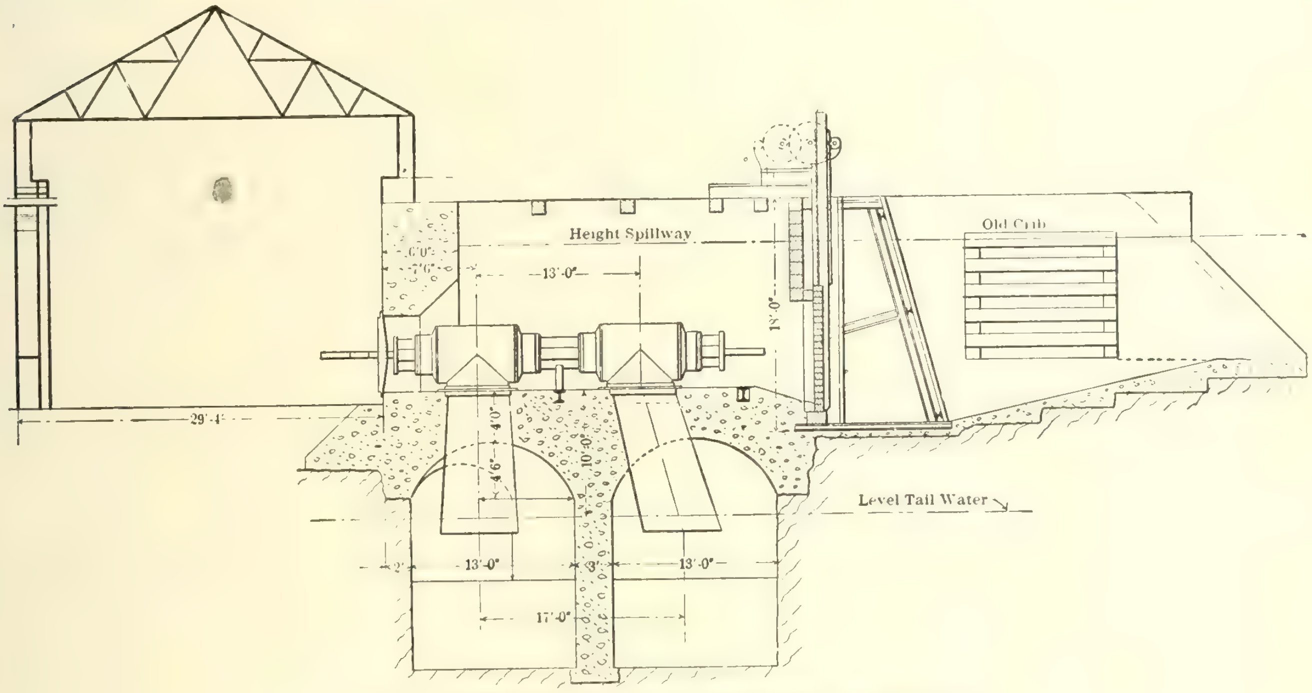

FIG. 1—SECTIONAL ELEVATION OF GENERATING PLANT.

One of the most important considerations in an enterprise of this character is the power for operating the machinery and grinding the cement. This may be estimated at about 24 h.p.-hours per barrel of output; and when steam is used this item constitutes a very considerable factor in the cost of manufacture. Power for the Raven Lake enterprise will be obtained from Elliotts Falls, thirteen miles to the north, where a water power electric generating plant for the purpose is under construction; and it is with the development of power at this point that the present article will principally deal.

Elliotts Falls is on the Gull River, a small stream in one of the principal chains of lakes in this locality which flowing south and east find their way eventually into Trent River and Lake Ontario. For many years the government has maintained a dam at this point, and a sluiceway to facilitate the "running" of logs, and the place was once the site of a small mill, which, however, utilized but little of the power available. The flowage of the river when last measured was somewhat under 600 second-feet and the fall from the spillway of the dam to the surface of tail water when operations were commenced was about 17 ft.

After careful consideration, it was decided to raise the dam 18 in., and by blasting out a ridge in the river below, lower the tail-water 3 ft., giving a total head of 21½ ft. With these changes it was considered feasible to develop a maximum of 1,200 h.p., and the work of designing the plant and supervising its construction was placed in the hands of the writer.

Referring to the sketch map on the following page, showing the falls and their immediate surroundings, it will be seen that the river flows in a southerly direction, and just below the falls expands into a sort of basin or lagoon lying somewhat west of the general course of the stream. The government works, most of which have been utilized, consisted of a wood dam at the top of the falls proper, and a timber crib connecting with it, extending up and down the stream and confining the water to the easterly channel. The dam is provided with a sluiceway at each end and extensive runways for the passage of logs.

The plan of development included a tail-race and wheel-pit to be blasted out of the solid granite rock formation just east of the crib referred to and extending up from the lagoon below to a point about 50 ft. above the dam. This was then to be covered by arches of concrete masonry supporting the three wheel chambers, which were made to communicate with the river above the dam through the medium of a fore-bay formed by removing a section of the crib and enclosing the space by concrete wing walls above and below. The dotted lines on the map show the relative location of the new work. The south wing wall was deflected at a right angle and carried down stream about 35 ft. to form the west wall of the sluiceway at the west end of the main dam, thus making it feasible at any future time to remove the main dam and replace it with a concrete structure without interrupting the continuous operation of the plant. The north wing wall was extended out 15 ft. beyond the up-stream face of the crib, which was heavily sheet-piled and reinforced by a puddle wall 3 ft. thick protected by a bank of gravel at a slope of one to one, riprapped with coarse broken stone.

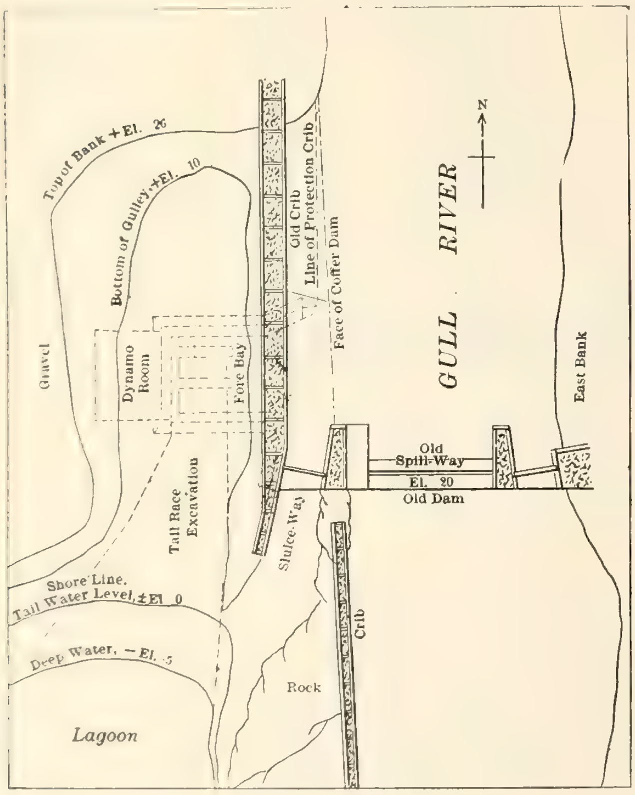

Fig. 2.—Sketch Map of Location.

As the main dam itself was very leaky, extensive repairs here were found necessary, but they will be only of a temporary nature, pending an entirely new structure in the near future.

In order to carry on the hydraulic work as above outlined, it was necessary to construct a coffer-dam from the west end of the spillway of the main dam to the west bank above the crib. The greatest depth of water found was about 7 ft., and the structure decided on was a cribwork of 10-in. x 12-in. hemlock sawed timber, 6 ft. wide on top, loaded with stone and sheet-piled with two layers of 1½-in. plank. This was found to answer the purpose satisfactorily.

The excavation of the wheel-pit and tail-race was carried on with rock drills of Canadian manufacture, the work being commenced at the north end and extended in a southerly direction toward the lagoon; the final breaking through into the river being deferred until everything was completed in the wheel-pits, and the draught-tubes and masonry supporting them were in place. The separating ridge was then blasted out, letting the water in, the debris being removed by dredging. In this way the necessity of a coffer-dam below the falls was avoided.

Fig. 3.—View of Old Dam from Below.

The entire masonry structure was of concrete composed of Portland cement, sand and crushed stone in the proportions of 1, 2 and 5. The cement was of Canadian manufacture, and suitable sand and stone were obtained on the ground. The concrete was mixed by a Jeffrey spiral mixer.

As the necessity for early completion required that much of the masonry be put in place during the cold winter months, a temporary building framed of rough poles and sheathed with inch boards covered with tar paper was constructed over the entire work, and the interior was kept heated with stoves and steam coils to a temperature of not less than 40° F. day and night until completion. In this way the progress of the work was rendered independent of weather conditions.

The power house was constructed with concrete walls and a wood-sheathed felt roof supported on steel trusses. The general arrangement may be seen from the ground plan and section elevation shown herewith.

The generating units, two in number, are each direct-driven by a bank of four 25-inch horizontal turbine wheels mounted on one shaft, which pierces the breast wall separating the wheel chambers from the dynamo room.

The turbines were furnished by the Jenckes Machine Company, of Sherbrooke, Quebec, and each bank of four has an ultimate capacity at full head of 600 h.p. on the wheel shaft. They are equipped with Woodward governors.

The generators have each a rated capacity of 350 k.w. and generate alternating current of 25 cycles. There are two exciters, each sufficient for the entire output of the station. One of them is designed to be belt-driven from the shaft of either of the main dynamos, while the other is provided with its own pair of turbines and is direct-driven.

The low-tension switchboard is of marble and is located at the north end of the building. It consists of a main panel, two generator panels, an exciter panel and a feeder panel, all equipped with the usual instruments and switches. The high-tension switchboard is of similar material and is placed at the south end of the room, the space between the two being occupied by the static transformers, which step the current up to 16,000 volts for transmission to Raven Lake. All wiring is carried in conduits placed beneath the concrete floor, and the station is protected by lightning arresters of the General Electric type. The entire electrical equipment was furnished by the Canadian General Electric Company.

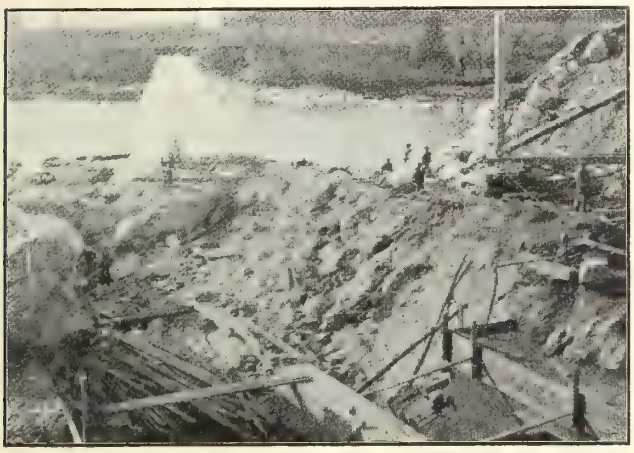

Fig. 4.—Excavating the Tail-Race.

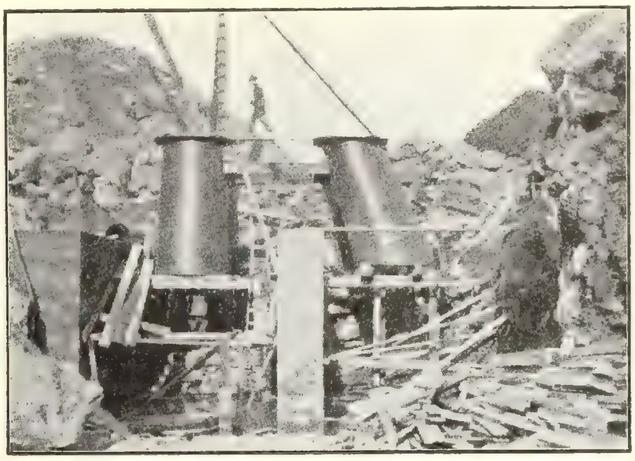

Fig. 6.—Setting the Draft Tubes.

The transmission line, between the generating station and the cement mill at Raven Lake, is supported on cedar poles, spaced 115 feet apart. The general arrangement may be seen from Fig. 5, representing a trimmed pole. Each pole has a single cross arm 4 in. x 6 in. of Georgia pine, with steel braces and Locke porcelain insulators. The conductors, three in number, of No. 2 aluminum cable, are carried, two on the cross arm and one on the peak, forming an equilateral triangle, 28 in. on a side. There is also a telephone circuit of two No. 12 galvanized iron wires, supported on a smaller cross arm placed 6 feet below and transposed every 500 feet. Both the cross arms and the braces are bolted through the poles with galvanized bolts.

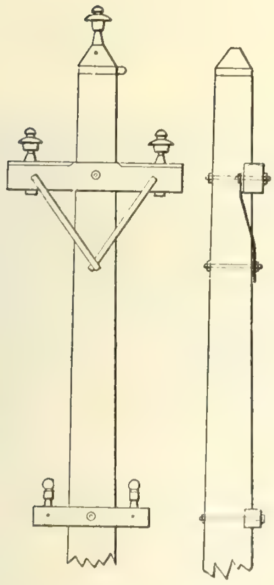

Fig. 5.—Transmission Pole.

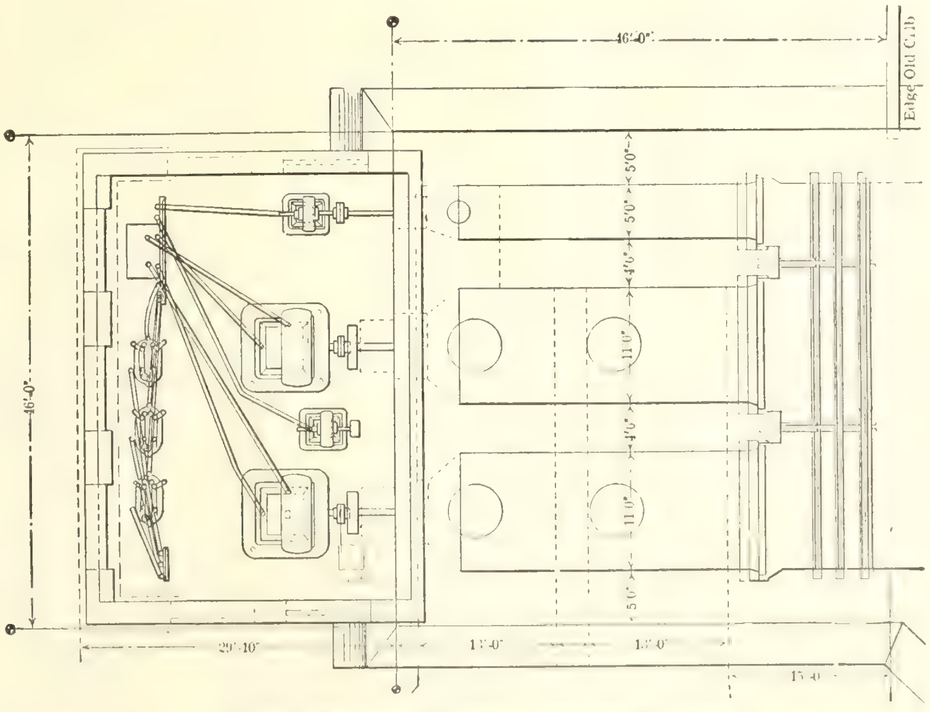

Fig. 7.—Plan of Power House and Forebay.

The poles vary in length from 30ft. to 45ft., being set to profile, avoiding all abrupt changes in level; and the line runs partly along the public highways and partly over private property, keeping it as straight as possible.

At the Raven Lake end there is a masonry substation 25x37 feet, in which are placed the static transformers which step the current down to 600 volts for use in the mill.

In this connection it is interesting to note the strides forward which mark the present era in the history of our cousins across the border; and the case in point, where almost everything needed was obtained from native sources, is but a slight indication of the growth which has taken place in the last decade.

The Canadian is nothing if not conservative, and turns his back squarely on the bubble of inflation. Born of a self-reliant stock, he thinks well of his own judgment, but does not disdain the assistance of others. While making haste slowly, his progress is exceedingly sure and unmarred by the fiascos which have brought many to ruin. With a supreme confidence in the good-will of his fellow-men, he takes kindly to a new idea only when he has become satisfied that it will pay, but once satisfied he embraces it eagerly, subscribes to it as far as his means will permit, and works with a will to help it along. For these reasons his banks are secure and his shares generally pay dividends.

The Raven Lake Portland Cement Company is a Canadian institution having its headquarters at Toronto. John Lucas is its president and Thomas McLaughlin its secretary-treasurer, and to the untiring energy and devotion of these gentlemen may largely be traced the success which has attended the launching of this enterprise.—The Electrical World.

AN ELECTRICALLY OPERATED SASH AND DOOR FACTORY.

The new mill of the Baltimore Sash & Door Company, at the corner of West and Sharp streets, Baltimore, Md., is a good example of modern methods, and illustrates the great advance made in machine installation and factory equipment during recent years. The arrangement of apparatus shows careful and skillful planning and permits easy handling of material, with a maximum saving of time and labor. No space is wasted, and yet about each machine there is abundant room for operation, together with free head-room and a noticeable absence of the intricate belting and shafting usually found in wood-working establishments. Good light abounds everywhere. These obvious advantages are largely due to the foresight of the managers of this company in adopting a system of electric distribution of power and a well thought out plan of motor drive. The plan of driving larger machines each by its own motor is skillfully combined with group driving for lighter apparatus, the conditions peculiar to the work to be done being the determining factor in this division. The mill has a present capacity of five hundred doors and six hundred complete window sashes per day of ten hours, or approximately one hundred and fifty thousand doors and one hundred and eighty thousand sashes in an ordinary working year. A specialty is made of high grade cypress and white pine.

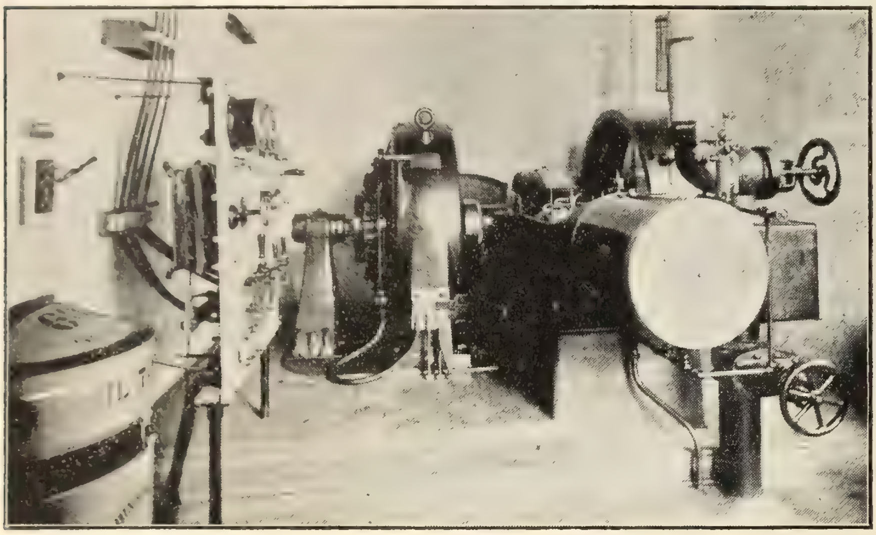

Fig. 1.—100 K. W., 250 Volt Westinghouse D. C. Generator and Ball & Wood Engine.

The main building contains two floors, the first occupied by the door and moulding departments, while the second is largely devoted to the manafacture of sashes. An electrically operated elevator connects the two and provides adequate facilities for handling the necessary material and machinery.

Exhaust pipes over each machine collect the sawdust and shavings and feed into a storage tank over the boiler-house outside the main building. In this way cleanliness is always secured, and fuel sufficient for the power needed is delivered to the boilers, practically without handling and at an almost negligible cost. Draught for this purpose is provided by a 55 inch Sturtevant blower, mounted on a platform under the ceiling of the first floor and driven by a 42 h.p. Westinghouse open type multipolar motor. The entire system of blower, piping, storage tank, etc., was installed by the Dixey Blowpipe Company, of Baltimore.

The power plant is located in a separate building. Steam at eighty pounds pressure is developed in a pair of horizontal return tubular boilers installed by the Thomas Brassher Company, of Baltimore, and equipped with appliances necessary for burning sawdust fuel. All dust and dirt of fuel are confined within automatic feed pipes leading to the furnace. Boiler and engine-room adjoin but are separated by a brick partition.

A 155 h.p. Ball & Wood simple automatic engine, direct connected to a 100 k. w. 250 volt direct cur-

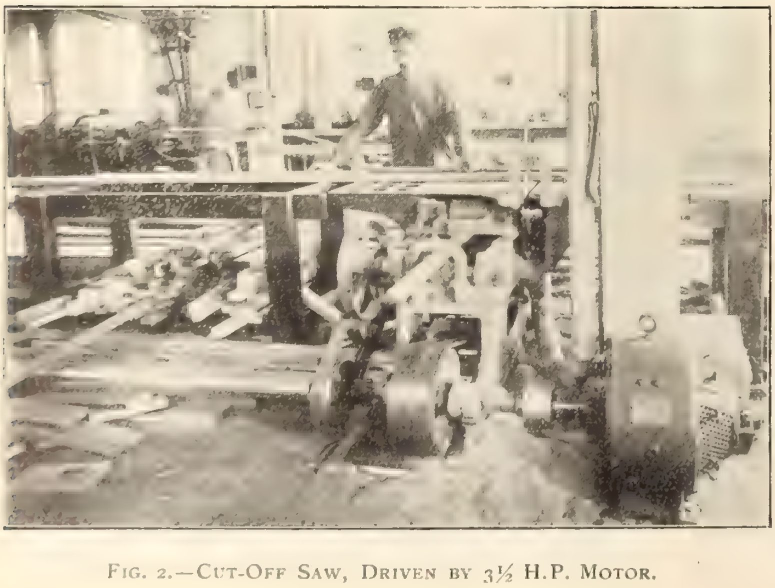

Fig. 2.—Cut-Off Saw, Driven by 3½ H.P. Motor.

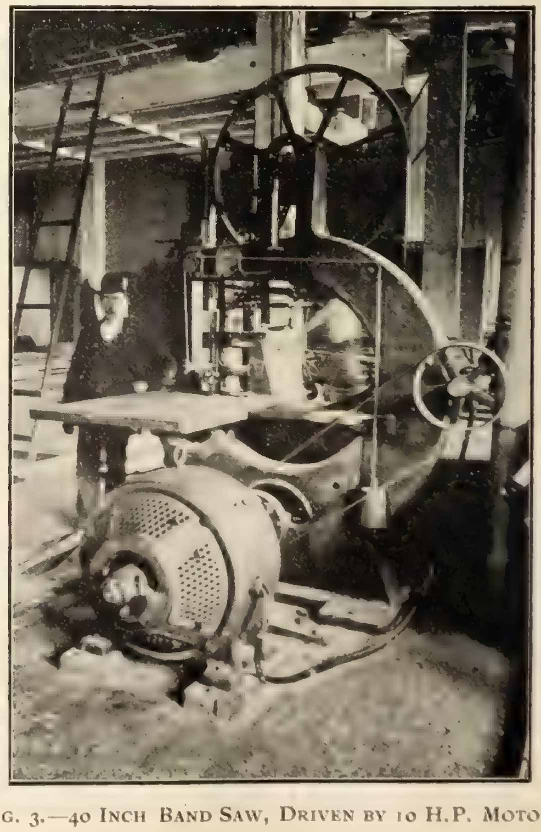

Fig. 3.—40 Inch Band Saw, Driven by 10 H.P. Motor.

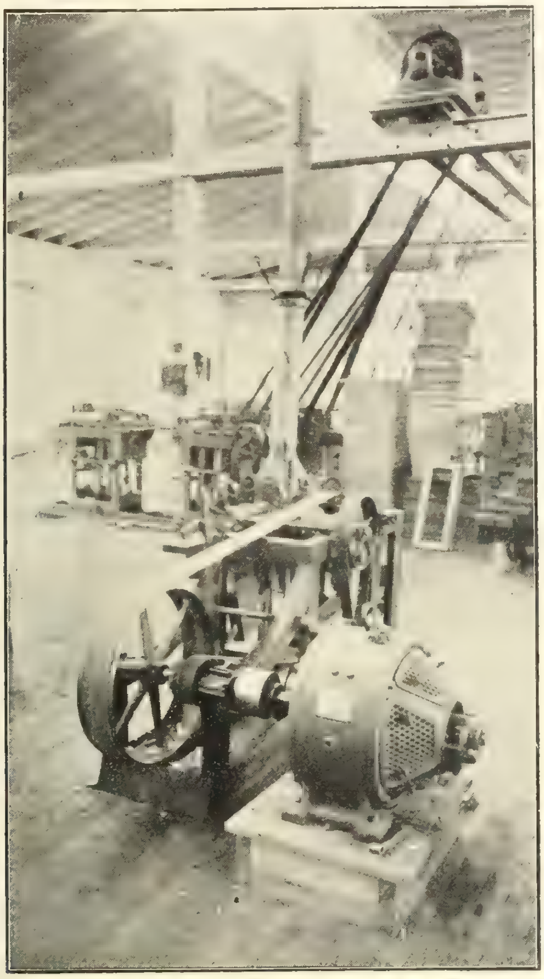

FIG. 4.—SASH STICKER, DRIVEN BY 3½ H.P. MOTOR.

rent Westinghouse generator, is at present in service. A second unit will be added later, as the mill is to be enlarged. A marble switch-board, with all requisite apparatus, furnishes control for the power and lighting circuits, which are run to distributing panels on each floor of the main building. From these distributing centers branch lines run to the various motors and lamps in each department. Means are also provided for the control of each motor at the machine or group of machines which it drives. Semi-enclosed Westinghouse direct current Type "S" motors have been adopted as standard; though a few of the multipolar open type are also used. Strong and compact design, high efficiency, large overload capacity and cool operation, combine to make the type "S" motor peculiarly suited to the requirements of machine driving. The larger motors are generally compound, the smaller shunt wound. There are, at present, about thirty motors with approximate total capacity of 250 h.p.

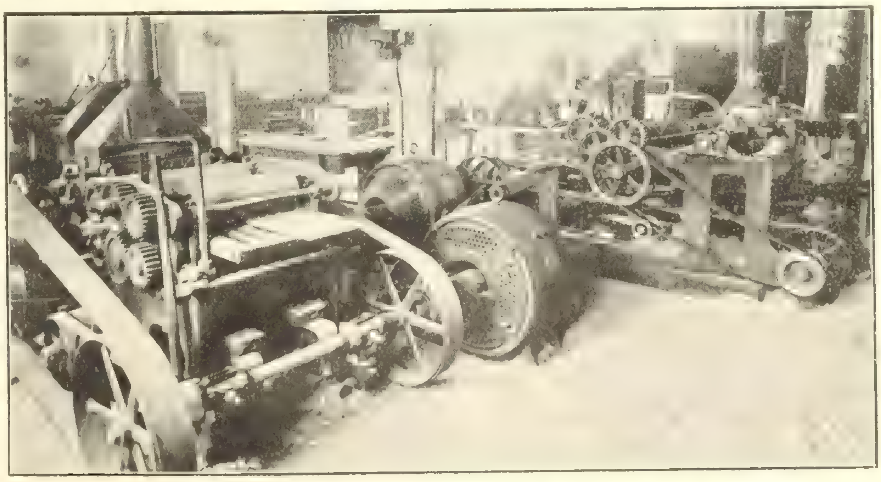

FIG. 5.—14-INCH MOULDER AND PANEL RAISER, DRIVEN BY 15 H.P. MOTOR.

The machine equipment consists, in part, of: 16 inch cut off saw, 4,000 ft. per minute, made by J. A. Fay & Company, with 3½ h.p., 700 r. p. m. motor; end paneller, made by E. B. Hayes Machine Company, with 3½ h. p. 700 r. p. m. motor; panel raiser, capacity 600 panels per day, E. B. Hayes Machine Company, with 15 h.p. 600 r. p. m. motor; 14″ moulder, J. A. Fay & Company, with 15 h. p., 900 r. p.m. motor; 9″ moulder, J. A. Fay & Company, with 10 h. p., 1000 r. p. m. motor; No.4 "American" 40″ band resaw, with 10 h.p., 630 r. p. m. motor; "American" double surfacer, with 7 h. p., 900 r. p. m. motor; 42″ band resaw, with 10 h. p., 600 r.p.m. motor; 16″ swing saw with 3½ h.p., 1600 r.p.m. motor; vertical shaft variety moulder, 3000 r. p. m., J. A. Fay & Company, with 2 h.p., 1200 r. p. m. motor; 42″ sander, J. A. Fay & Company, with 15 h. p., 650 r. p. m. motor; scroll saw with 2 h.p., 1200 r.p.m. motor; eight drill rail borer, E. B. Hayes Machine Company, capacity 600 rails per day, with 6 h.p., 700 r. p. m. motor; door clamp, E. B. Hayes machine Co., one door per minute, with 3½ h. p., 1120 r. p. m. motor; dowell driver, E. B. Hayes Machine Company, with 3½ h.p., 700 r.p.m. motor; double end tenoning machine, E. B. Hayes Machine Company, with 15 h. p., 1100 r.p.m. motor; 28 in. drill stile borer, E. B. Hayes Machine Company, with 10 h. p., 630 r. p. m. motor. This machine will in one day turn out material for 1200 doors.

On the first floor a 3½ h. p. motor operates a small group of emery wheels and saw files in the repair shop. In the sash department 10 h.p. and 15 h.p. motors, respectively, operate two short line shafts, to one of which is belted two "American" sash stickers, one hollow chisel, one franking machine, one buzz planer and one gang rip saw, while the other drives a six inch, four sided moulder, one combination saw, one single end tenoning machine, one "American" sash dove-tailer, one chain mortiser, one pony planer, and one emery grinder.

During six months' operation the mill has more than filled the expectations of its owners, and has again demonstrated the convenience and economy of motor drive for work of this character. Large orders have already covered the entire output and made an increase in capacity necessary. Additions are being prepared and largely increased facilities provided to meet the growing demand for a well made product.

The Western Electric Manufacturing Company, Limited, Berlin, Ont., has been incorporated, with a capital of $50,000. It is the intention to manufacture electrical machinery, electric, gas and water meters, gas engines, etc. The promoters include Messrs. W. H. Cone, electrician, Peter Hymen, merchant, and J. J. Weir, solicitor.

The Sudbury Power Company have installed two generators in their new station on the Vermillion river at Larchwood, Ont. It is expected to develop two thousand horse power, which will be used at Copper Cliff, Chelmsford and Sudbury. Mr. J. B. Gordon is at the head of this company, and Mr. T. T. Simpson, of Ottawa, is their consulting engineer.

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AND ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Electrical Standardizing Bureau.

The opinion is held by owners and managers of electric lighting companies registered under the Electric Light Inspection Act that they should receive something in return for the comparatively heavy fees which they are called upon to pay. The government will probably be asked to establish an Electrical Standardizing Bureau, to be maintained independent of any by other branch of the public service, and placed in charge of a qualified electrical expert, at whose disposal should he place trained assistants and proper facilities. The purposes for which such a Bureau is required are: for obtaining arc and preserving absolute standards for the measurement of electrical quantities; for giving the standard measurement of these quantities, and to enable the electrical expert to make such tests of instruments and materials as may be necessary in the performance of his duties. The scope and operations of the Bureau should cover the adjustment and standardization of commerical electrical instruments, other than electricity supply meters; the photometric measurement of the candle power of electric lamps, etc.; the supplying of standard lamps for photometric purposes. As the fees collected from the electrical companies exceed by several thousand dollars the amount required to pay the cost of inspections, it is hoped that the government may be willing to apply the surplus with any further sums that may be necessary towards the establishment of a Standardizing Bureau.

Central Station Equipment.

The general interest awakened throughout the country by the preparations to transmit Niagara power to Toronto and the possibility of its being distributed throughout South-Western Ontario, has stimulated the sale of electric energy and has created in many cases a demand for a power service where no provision has heretofore been made for it. Lighting plants have been installed in scores of towns with no thought of their ability or inability to cater to possible power users, and many a station is now asked for a power service it is unable to furnish on account of the unsuitability of its system for motor work. This is true mainly of stations equipped with high frequency alternators, of 125 or 133 cycles, and such plants whether single phase or polyphase, are unquestionably seriously handicapped in this respect. It will probably be accepted as a general fact that the first cost of the motors necessary has considerable to do with the decision of a power user as to whether he will use electric power or not, and the possibility of establishing a profitable day service in connection with a small plant frequently depends on this point. As the manufacture of polyphase induction motors for the frequencies stated has practically ceased, such plants must have recourse to single phase motors, and as the cost of these motors for 125 or 133 cycles is very high as compared with 60 cycle machines, and still more so as compared with direct current motors, it becomes a matter of great difficulty to get customers for electric power, and the attempt has often to be abandoned. Notwithstanding the fact that this experience has been so general, many plants to-day go on buying high frequency generators without properly studying the situation or keeping in mind the requirements of the future or impending developments. Many cases have occurred during the past two years alone where stations equipped with perhaps only one small high frequency machine, have doubled or trebled their capacity with generators of the same type, and to-day it is realized that a serious mistake was made. We believe that all central stations operating high frequency machines will do well to consider, before it becomes too late, that sooner or later a change will have to be made, as undoubtedly such machines have no place in the modern development of electrical machinery.

In considering the question of the transmission and distribution of the Niagara power it is important to bear in mind that the power will be transmitted at 25 cycles, and if we may judge by the practice followed in other long distance transmission projects on a similar scale, the company transmitting the power will not act as distributors but will sell the power to the various lighting and power companies or municipalities ; this, combined with the fact that a frequency of 25 cycles is unsuitable for lighting work, either arc or incandescent, will undoubtedly lead to the bulk of this energy being distributed by means of the plants already installed by the various local companies and munlicipalities. It is true that 25 cycle power could be distributed for motor work, but in most cases it is hardly probable that it would be desirable to have two different systems of distribution over practically the same area. We believe that this is a point frequently lost sight of by parties interested in the possibility of obtaining power from long distance transmission lines, and it emphasizes the importance of the point raised above, that very careful consideration should be given to the question of frequency, not only in lighting plants about to be installed, but in those cases where it is intended to increase the capacity of existing plants. An important question might here be raised, that is, does the design and installation of the average small central station receieve the attention it should? We are inclined to think not. In very few cases are reliable engineers consulted, and either a local man of limited experience is relied on or the members of the board or council, as the case may be, have to decide on propositions of many and varied hues submitted by and fought for by representatives of the manufacturers who are rarely in a position to give disinterested advice. Such cases demand the services of a properly qualified engineer. We believe that if owners of plants appreciated the importance of securing proper engineering advice and of following that advice, there would be fewer candidates for the scrap pile than now adorn many stations, fewer complaints from customers dissatisfied with an unreliable service, fewer complaints from shareholders about dividends that do not materialize and the whole business of the supply of electric energy would take on an entirely different aspect.

Electric Traction on the New York Central.

As our readers are doubtless aware, the New York Central Railway has for some long time been seriously considering the adoption of electric traction for various parts of its lines, more particularly those in and immediately adjacent to New York City. The investigations which were made by them to determine whether or no the change was practicable, and if so the best system to adopt, have now resulted in the placing of one of the largest orders ever given in America, if not in the world. The successful tenderers are the General Electric Company, the contract price, so it is understood, amounting close onto $20,000,000. The order includes the generators, eighty in number, which will be three phase 25 cycles, 11,000 volts, 5,000 k.w., the steam turbines for driving them, of 7,500 h p. nominal capacity, and the locomotives. These latter, of which thirty have been ordered, will weigh somesomething over eighty tons, and are to be capable of hauling a 500 ton train at 60 miles per hour. They will carry four gearless motors rated at 500 to 600 h.p. each, and being equipped with multiple unit control are capable of being coupled, two or more, into virtually one unit. The present contract does not include any provision for the large equipment of rotary converters, transformers, switchboards and the many accessories which will be necessary, so it will thus be seen that the plant in its entirety will represent an enormous capital investment, and that it will mark a tremendous advance towards electrification at least in part, if not wholly, of many roads now operated by steam.

CANADIAN ELECTRICAL ASSOCIATION.

Arrangements for the annual convention to be held in Hamilton in June are well under way. The Committee on Papers, of which Mr. R. G. Black is chairman, have succeeded in securing a very valuable and instructive series of papers for this Convention by well known authors. The Excutive will meet ahout the 1st of May to fix the exact dates and complete the programme.

Much interest is being taken by the members in the Question Box which, under the able direction of Mr. A. A. Dion, of Ottawa, promises to become a source of valuable information to the members.

There is much of interest to electrical men to be seen in and about Hamilton. Many changes and improvements have been made to the Hamilton Electric Light and Cataract Power Company's system since the Association last met there. There is also the new works of the Westinghouse Electric and Manufacturing Company. It is not unlikely that a day will be spent in visiting the great power development works in process of construction at Niagara Falls.

THEFT OF CURRENT.

Many cases have been brought to our notice in which large quantities of current have been stolen from the wires of electric lighting companies, and so great has been the ingenuity of the thieves that it was found impossible to bring the crime home to them.

An amendment is required to section 10 of the Electric Light Inspection Act or the Criminal Code to more effectively protect the supply companies. Under the law as it now stands it is impossible to procure a conviction owing to the fact that the manipulations of the wires, etc., necessary to divert the electric current is carried on within the precincts of the consumers' premises where it is not possible to establish individual guilt. The law should be so amended that the finding of such manipulations or changes of the wiring or apparatus on the consumers' premises, in such a manner as to divert the electric current or prevent the meter from accurately recording the amount of electric energy consumed, should be considered prima facie evidence of the consumers' guilt.

BANQUET OF ELECTRICAL CONTRACTORS.

Tuesday, March 22nd, will be long remembered by those present at the second annual dinner of the Electrical Contractors' Association of the Province of Quebec, as it was one of the most pleasant, as well as instructive and interesting, in the history of that Association. The Association is as yet quite young, but the amount of good it has already accomplished, by cementing the friendship and interests of its members, has been a surprise to the members themselves.

The dinner was held in the heart of the city of Montreal, in "Welsh's Banquet Hall," where a right royal table was spread. The menu was sufficient to whet the appetite of the most particular and fastidious electrical expert.

The company present was a most representative one, visitors being in evidence from many of the allied industries. The proceedings, which were sufficiently jovial to make the social side no mean part of the programme, was by no means allowed to overstep the business importance of the occasion.

The ceremonies were opened about nine o'clock by the very able president, Mr. N. Simoneau, with the intimation that the time had come for the "battle of knives" to commence, each guest thereupon taking his alloted place, and "work" proceeded in as business like a way as could be expected on such an occasion, the "contract" being executed with a degree of "promptitude," "dispatch," and "satisfaction" which would surpass many other associations and in a manner born only of long experience such as the Electrical Contractors' Association has perfected themselves in.

Mr. N. Simoneau,
President Electrical Contractors' Association, Montreal.

The chairman duly announced that "work completed" according to "contract," and well up to "specification," he would without further ceremony hand over the conducting of the meeting to their active and popular secretary. At the same time he expressed his great appreciation of the honor that had been done him in electing him president of the Association. It would be his pleasure to place at the disposal of the Association any information which he had gained in his long and practical experience in the electrical business, and he would do all he could for the benefit of the Association during his term of office. He called upon Mr. Hill to take over the order of the meeting.

Mr. G. H. Hill, the secretary, in his opening remarks, reviewed the progress which had been made in the two short years of the life of the Association. Now, in place of the former animosity which had existed between rival firms, was to be found a firm friendship and consideration one for another. The Association had welded its members together in a solid body, making them to feel identity of interests, and had brought into being a friendship which had commnnity of interests as its foundation, and mutual prosperity for its goal. This had not been accomplished without a good deal of deep thinking, for which he felt great credit was due to their first president, Mr. Shaw, and their immediate past president, Mr. Scott. There had been troubles of many kinds through which those gentlemen had safely led them. They had entered the field no doubt in the flush of youth, and had of course discovered many difficulties and many obstacles but they had passed safely through that stage and had entered into the sobriety of mature life in the Association's history, and he could say that they had come through better than was expected.

Mr. Hill then called upon Mr. W. B. Shaw as the first president for a few remarks. Mr. Shaw, however, with his natural reticence, refused to be drawn into any lengthy discussion, saying that Mr. Hill had put things before the meeting in such perfection that nothing was left for him to say, beyond that he felt that the Association had established itself in a way that gave every confidence as to its future usefulness, and that Mr. Hill had put on the plaster a good deal thicker than it would hold, in his remarks regarding himself (Mr. Shaw.)

Mr. Scott then followed as one of the past president's expressing his satisfaction with the past history as well as future prospects of the Association. He remembered the time when they did not know one another if they met in the streets, and the rivalry that then existed could not be well described; they seldom knew who it was they were competing against, so ignorant were they of one another. And as for any idea of mutual interests, such an idea had not been conceived; but it was very different now, they were pulling together and presenting a solid front. This had not been accomplished without an up-hill struggle, but they had kept together and mounted the top successfully. Several good points had been gained for society at large, in the gaining of the important point of inspection promised by the city authorities.

Mr. Shaw, the first president of the Association, now proposed the health of the "Supply Dealers," which was responded to by Mr. Buck, of the J. A. Dawson Company. He expressed his pleasure at being amongst their number that evening. He had not contemplated meeting a company so full of energy for the cause upon which they had entered and showing such determination to go forward in their purpose. He need only refer in passing, to the fact that the Association which had once existed amongst the supply dealers had not continued, but he felt that he was only expressing the united feelings of that industry when he wished every success to the Electrical Contractors' Association and he hoped to be able to attend many future gatherings of this kind.

Mr. Andrew Forman then followed to confirm the good wishes of the supply dealers. There were some seventy to eighty electrical contractors in this city and he saw no reason why every one of them should not cast in their lot with such an Association. He heartily wished the Association every prosperity.

Mr. Moncel, one of the executive committee, here proposed in French the health of the "Manufacturing Industries" which was responded to by Mr. Smith, of the R. E. T. Pringle Company, who said he could not help thinking that the interests of both contractors and dealers were closely woven together; one could not well succeed without the co-operation of the other, and if this Association proved really to be studying the interests of the trades, in a large-hearted and open-minded manner, there was a possibility that the manufacturers might take still further interest.

Mr. Rough, of the Packard Electric Company, here followed in the continued expression of good will on behalf of the manufacturing industries. This Association reminded him very forcibly of a little occurrence he recently witnessed in one of the main thoroughfares in Montreal. During the very severe weather an old man was leading his horse with a heavily laden sleigh of coal, when by some unforseen cause the whole was turned over, immediately in front of a coming car, and traffic was quickly disorganized. In a few minutes the roadway was blocked with a string of cars, and it, to all appearances, looked as if traffic was going to be completely at a stand-still, but there appeared on the scene two of the old man's companions with empty wagons returning from their labors, and they all soon set to work to assist him in his misfortune, and as if by magic the disorder was transformed. By their united efforts they had achieved what it would have been impossible to have accomplished by an individual. Traffic was resumed and a fresh comer on the scene could not have told that anything had been the matter. This, to his mind, was an illustrarion of what had been accomplished by the united efforts of the Electrical Contractors' Association. He remembered when it was first conceived, and he could well understand the amount of work that had fallen upon the officers of the association to bring it to its present influential position. He believed that they were now doing better work and holding together for general good, animosity had been removed, and a feelings had been levelled, so that they could meet in unity round the festive board.

Mr. Douglass, of the Hill Electric Switch Company, followed, saying that the evening wss one of those moments which could be readily described as one of the proudest of his life. He was very glad to be found there, they had put through the first year safely and had laid the basis for their future success and prosperity.

Mr. Horner, of the Canadian General Electric Company, expressed his pleasure at being enabled to attend a meeting of such interest, and considered that the electrical contractors could not fail to gain strength from meetings of this nature. He considered that organization was the great secret of continued strength and prosperity, and this was all assured to the electrical contractors by the assocciation at whose invitation they had met together that evening.

Mr. Hill followed and expressed, on behalf of the Association, their hearty thanks for the cordial and whole-hearted manner that the interests of the Association had been taken up by the last three or four speakers. They had really hit the kernel of the object of the Association, it was not merely a selfish "dog in the manger" idea, wrapped up in themselves, but one which had a larger interest of the trade and profession at heart, and one of their leading objects was to cement every interest together and to advance in skill, knowledge and enterprise, as well as seeking to maintain financial success.

Mr. Scott now proposed the toast to the visitors, which was responded to by Mr. Frederick Bruce Horn, who in the course of his remarks said that he would like to enter a plea on behalf of the "young men" for an opportunity of obtaining a better technical knowledge of the electrical business; this would be in the interest of both the employer and his workmen. In a general and public way the Monument National classes were doing good work. The Y.M.C.A., he understood, were intending to establish technical work shops when their extensive building is completed; but directly the members would receive little benefit from this source.

The meeting was then brought to a clcse by a vote of thanks to the president, treasurer, and executive committee. The proceedings were enlivened from time to time between the speeches by musical talent and altogether a very enjoyable as well as profitable time was spent.

ELECTRICAL EQUIPMENT FOR CORNWALL CANAL*.

By F. H. Leonard, Jr.

The electrical equipment for the Cornwall Canal is supplied with current from the power house of Mr. M. P. Davis, near Mille Roches, on the Cornwall Canal. Messrs. T. Pringle and Son were the engineers and the electrical equipment was installed under the personal supervision of the writer.

The arc lights, of which 225 are located along the bank of the canal, were furnished by the G.I. Company, of New York. A three panel switchboard controls the operation of these lamps and each circuit is regulated by a 100 light G.I. regulator capable of maintaining practically constant current with any number of lamps in circuit from 1 to 100—its full capacity. The current for these circuits is stepped up from 2200 volts by means of transformers of 60 k.w. each—the transformers being provided with intermediate taps so that besides the full voltage of 11,000 volts, if a smaller number of lamps are required, either 4,400 or 6,600 volts can be used, thus reducing the reactance necessary to maintain a proper voltage and permitting of a higher P.F. under the conditions of partial load.

Current for the power circuits, three in number, is obtained by stepping up from the generating voltage to 11,000 volts by means of three 150 k.w. transformers which supply the 3 phase transmission lines reaching various locks along the eleven miles of canal. The primaries of both arc lighting and power transformers are controlled by oil switches connected to the bus bars on the main switchboard, a separate panel being provided for each class of service. The power circuits are passed through a separate high potential switchboard which connects the transformers to the three separate 3 phase power lines. A 2,200 volt line also provides Mille Roches with light and power service.

Lightning arresters and choke coils are provided for the various circuits. The wiring of the station between generator and switchboards to the wire tower, from which the circuits are fanned out to different poles lines, are all carried in 3 conductor cable lead encased, suitable trenches being provided in the concrete floors, allowing ample space for additional cables.

The pole lines for the lighting and power circuits are of substantial structure, an exceedingly straight lot of cedar poles being used. These range from 30 to 50 feet in height, none having less than 7 inch tops, on which are mounted special cross arms provided with hickory pins which were boiled in steric acid; 5½ inch triple petticoat glass insulators being used with satisfactory results with the 11,000 volt circuits. Bare copper conductor is used spaced 16 inches on centres, and on account of the low current per line no attempt was made to use the triangular arrangement of conductors, the three wires of each circuit being arranged side by side without transposition.

The 3 phase power circuits occupy the upper arms and on the lower arms are located the single phase arc circuits. The main lines occupy the south bank of the canal. Crossings are made at the Mille Roches bridge in armoured paper cables, one for three phase 2,200 volt power and lighting circuits and another for the single phase 11,000 volt arc circuit. Another crossing is made at lock 18, which provides for three-phase power circuit, as well as another 11,000 volt arc circuit to provide for power and lighting on the north bank below this point. At the Stormont bridge, near Cornwall, another 11,000 volt arc cable provides for lighting the two piers at the bridge and an emergency cable is laid just above lock 17 so that in case of accident to any of the other crossings or a break in the line, emergency connection can be made in the houses covering the cable heads on the bank of the canal.

While in some cases sawed octagon poles have been used for a similar purpose, yet the shaved cedar poles selected for this work present an exceptionally pleasing appearance. Extreme care has been taken in locating and setting out the line; a transit has been used for this work, making the alignment and location almost perfect.

The line is well guyed on the curves with galvanized signal strand well anchored, or in some cases tied to a heavy guy stub. On the sharp curves, poles are double armed to provide for the severe strain.

LIGHTING.

The lighting of the canal is carried out in a very liberal manner, an arc lamp being located on every fourth pole and the poles averaging about 100 feet apart. At the locks, as many as twelve or fourteen lamps are located so as to brilliantly illuminate both ends of the locks, as well as the intervening space and the regulating wiers, most of which are located beside the locks.

The lamps are hung from iron pipe brackets which pass through the pole and are held in place by a collar at the front side and a lock nut at the back and braced on the under side by an iron pipe strut fastened to the face of the pole by two lag screws. An insulated hanger is used at the outer end of the bracket (2 ft. 6 in. from the pole), which, together with the insulators on the lamps, renders danger from grounding in the lamp frame and bracket extremely remote. The lamps are trimmed from the pole without lowering; pole steps are driven in each lamp pole.

Loops are cut in from transposition insulators by means of No. 8 flexible rubber covered conductor soldered to the bare copper line conductors, particular care being taken to support the connection at the lamp so as to avoid any possible danger of the swing of the lamp causing a break at the binding post. Some trouble of this character was at first experienced but was soon overcome by the above provision.

At the lower end of the canal, where three sets of locks are grouped together, the illumination is very brilliant, and viewed from the Stormont bridge at Cornwall—taking in at a single glance some 60 arc lamps reflected in the still waters of the canal—the sight is most impressive in its quiet brilliancy. The illumination of the locks is so much alike that a description of one will convey a very clear idea of them all.

A light is located at the piers as the lock is approached from below and an arc lamp is also located at each side of the lock just below the gate; two more lamps are located at the middle of each lock and two at the upper end of the lock just at the lock gates. There are also two more at the upper piers, and as two locks are located side by side, you can imagine that the illumination would almost rival daylight. Below lock 18 both banks are illuminated all the way by lamps located 400 feet apart. Above lock 18 the lamps are located on the south side of the canal only, with the exception of prominent points, bridges, etc., where lamps are provided on both sides.

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*Abstract of a paper read before the Electrical Section of the Canadian Society of Civil Engineers, Montreal. For description of hydraulic and generating equipment of power house see Electrical News, March, 1902.

The upper level broadens into a lake of considerable proportions, about 30 feet deep near the lower end. The dam retains the water between Shiek's Island and the Canadian shore, making a broad and easily navigable waterway of about three miles to the upper dam. The lamps are here less frequently located on the prominent points on the south side until the upper dam is reached, when the canal again narrows to the usual dimensions. The lamps are again located about 400 feet apart on the south bank up to lock 21, which is a guard lock, there being very little difference between the upper canal level and the St. Lawrence River at this point. On the long pier on the south side protecting the canal entrance lamps are placed, as well as on the north bank as far up as Dickinson's Landing.

An illumination so perfect as above described, you can readily imagine, makes navigation at night as easy as in daylight, and lockages are performed as rapidly and as easily as they could be in day time.

LOCK HOUSES.

At the upper end of each lock on the south bank there is located a small switchboard cabin, 7 ft. x 9 ft. ; on the little island between the two locks is located another switchboard cabin and at the upper end of the lock on the north side of the second lock is another cabin. In the first of those above mentioned are placed three transformers and connecting to the 11,000 volt mains, which step voltage from the line pressure to 550 volt, and it is at this pressure that the motors operate. A high tension fuse board is provided to take care of the primary connections to the transformers. The long enclosed fuse has friction contacts at either end and by pulling these fuses out of the end clips by means of a wooden stick with a hook at the end, the circuit can be opened in case of temporary trouble, or for any purpose whenever it becomes necessary to disconnect the transformers. The secondary of the transformers passes through the switch on the switchboards which distribute the secondary current to the motors, two of which are located on each side of the lock. Armoured cable with paper insulation is used to conduct the current from the switch cabin to the motors located on the same side of the lock.

The connection for motors on the opposite side is carried through armoured cable which leads down through the floor of the switch cabin and passes through a hole drilled in the stone coping of the lock to the upper stop log check ; there being two checks cut in the masonry, this leaves one which could be utilized for stop logs in case it ever became necessary to keep the water out of the lock during repairs. The cable turns over a radius of 16 inches at the top and passes down the check, being protected by a piece of oak plank which is grooved in the centre to take the cable, the plank being fastened by drift bolts to the stone work and protected at the edges with iron strips. As the plank does not come above the edges of the check in the stone work, there is practically no danger of the cables ever being injured by a boat in entering or leaving the locks.

Where the cable crosses on the lock bottom a timber is held on top grooved on the bottom side to receive the cable, and as the top of this timber is well below the breast wall at the entrance of the lock, there is no danger of the cable ever being disturbed.

Rising on the opposite side of the lock in the stop log check, the cable again passes through a hole drilled in the stone coping until it comes out of the earth back of the masonry under the next switch cabin ; from this switch cabin the cable is carried into the third switch cabin on the north side of the old locks.

You will bear in mind that the new locks were built on the south side of the old locks and are about 70 feet longer, the old locks being 55 feet wide and 200 feet long inside the gates and the new locks 45 feet wide and 270 feet long inside the gates and 14 feet over sills.

On the switchboards in each of the cabins are placed the motor starting switches connected to auto starters which control the motors on one side of each lock. From the switch cabin on the south side are operated two motors, the first motor being connected by armoured cable reaching from the switch cabin underground to the first motor. The second motor is reached by conductors running from the switch cabin overhead to a pole very near the motor at the lower end of the lock—armoured cable connecting from the pole underground as far as the masonry and checked into the masonry where it passes over to the motor.

The switch cabin on the little island between the two locks controls the two motors on the north side of the new locks and two motors on the south side of the old locks. The third switch cabin controls the motors on the north side of the old locks, as well as the motor operating the wier gate mechanism.

The arrangement is identical in all the locks with the exception of No. 15 and old lock 16, which are not provided with wier gates. The equipment for operating the lock gates and wiers was adapted for use in connection with the winches and wier gate mechanism already installed without disturbing their capability for hand operation should occasion require. When these devices were operated by hand, the lockmen laboriously turned a crank on the winches at the two opposite sides of the lock gates, utilizing one winch for opening and the other for closing the gates. Four winches were located at each end of the lock, two on each side, one of which handled the chain to close the opposite gate, the other to open the gate on the side at which these winches were located. Across the top of each gate is a bridge on which is mounted the worms and rods for opening the two valves in each of the gates when required to fill or empty the lock.

The electrical equipment utilized practically all of this machinery as it stood with only the necessary changes to make the mechanical connections with the electrical drive.

In order to keep the speed down to approximately what was obtained by hand operation, a very material reduction in motor speeds was necessary. To obtain this and cover the other points, special apparatus was devised and patented by Mr. Alex. Pringle and myself, which will be shown in the views to be presently thrown upon the screen.

The motors selected were all of a 5 h. p. for both the lock gates and wier mechanism. Some question as to whether a 3 or 5 h. p. motor should be adopted arose, but the matter was decided in favor of the 5 h.p. motor on account of its lower speed, and while the capacity of this motor is never exceeded except for a few seconds, the balance of the time running considerably under load, yet the whole arrangement is simple and while somewhat stronger than absolutely required, the interchangeability and greater durability we thought justified the slight additional expense.

To operate the two winding winches which control the chains for opening and closing the gates, one motor is located near the hollow coin at the heel of the lock gate—which is coupled by means of short length of shafting and friction clutch coupling to the winch near this point and by means of another friction clutch and length of shaft sufficient to reach the other winch, supported at intermediate points by pedestals carrying journal boxes mounted on cut stone blocks jointed to the coping, making a practically continuous stone foundation for the mechanism.

The arrangement of the motor bed, gearing and speed reduction you will understand more clearly by referring to the drawing showing the casing for the worm gear and motor bed.

As there is a reduction of about 42 to 1, which gives a speed of about 26 revolutions for the operating shaft, we concluded to use the worm gear rather than a more complicated triple reduction by means of spur gears. A sub-base extends under the motor and also carries the casing for the worm and worm gear. The worm runs in oil, the thrust being taken up by alternate steel and bronze collars and thrust discs, adjustable at one end by means of set screws and check nut to compensate for wear.

The motor, which runs at 1,200 r.p.m., is coupled directly to the worm shaft, the worm being cut out of solid steel and meshing into a hobbed bronze wheel turning on a shaft mounted on babbitted bearings; the projection at one end of this shaft having mounted upon it the friction coupling controlling the working shafts. The opposite end being coupled to a short length of shaft which carries a chain wheel similar to a sheave in a chain hoist and from this point by means of a welded link chain made endless, is turned at an angle to the main working shaft, the supplementary shaft for operating the valves in the lock gates. This shaft is supported on bearings secured to the coping of the lock and placed about ½ inch above its surface and continued under the bridge on the lock gate, a universal coupling being utilized at a point near the gate pivot so that the travel of this joint is minimized.

The arc of the circle through which this coupling passes is provided for by a swivel box carrying the end of the driven shaft, and the travel in and out is allowed for by having the chain sheave run free on the shaft except when engaged by a jaw clutch keyed to the shaft so as to allow the shaft to run in and out as it passes through this arc and engage or disengage the clutch at the proper time for controlling the valve mechanism. The clutch being disengaged allowed the driving sheave to run loose on the shaft, the shaft itself remaining idle during the time the gate is open and is only put into operation when the gate is swung to the closed position.

The valves are operated by bevel gear reversing mechanism which allows the operator to either close or open the valves in the gates by throwing the shipping lever which engages a jaw clutch with one of the bevels required to operate the valve stem in the desired direction. The travel of this stem, however, is limited by an automatic stop consisting of a loop and bell crank operated by a pin in the cross head travelling with the valve stem so that at the lower or upper limit of travel, the pin trips the bell crank connecting with the shipping lever so as to throw the clutch out of engagement with the bevel gear which produces the motion.

This mechanism permits of much more rapid lockage than could be carried out by hand and reduces the necessary force of lockmen to one-half the crew formerly required.

LOCKAGES.

While the usual lockage is perhaps a familiar sight, many possibly do not understand it and a short description will not be out of place.

We will assume that a barge is proceeding up the canal, following another which has previously passed in the same direction. The lock would, of course, be full of water up to the level of the section above. As the barge approaches the lock, the lockmaster starts the motors at the lower end by means of the starting switch on the switchboard in the lock house and two of the lockmen proceed to the lower gate and open the valves, which allow the lock to empty into the lower reach; the mechanism is started on all four valves one after the other. One of the lockmen crosses to the south side and the other to the north side. The mechanism operating the valve stems continues to operate until the valves are wide open and the pin trips the operating mechanism, leaving the valves in this condition until the water within the lock has reached approximately the level of the lower reach. The lockmen on each side of the canal then throw in the friction clutch which connects by means of a short shaft to the pinion meshing into the large spur wheel on the winch. This winds up the slack on the chain which runs through the chain well over a roller and out to a hook about four feet above the sill at the outer end of the lock gate.

As soon as the slack is wound up, the chain commences to move the gate, opening it till it leaves the passage free for the entrance of the barge into the lock. As soon as the boat is moved into position and made fast, the gate is closed by throwing in the opposite clutch which operates the winch at the opposite end of the shaft and closes the gate — the clutch on the first winch being released, of course allows the chain to pay out as quickly as required to allow the gate to close.

As soon as the gates are closed, the clutch operating the shaft which drives the valve mechanism has moved into engagement and starts the valve driving mechanism, the lockmen threw the lever, starting the two valves in each of the lock gates to close and immediately walk over to the other end of the lock; before they reach it, however, these valves have closed and the tripping mechanism has thrown the clutch out of gear. The valves in the gates in the upper end of the lock are then opened in a similar manner to that described in the emptying of the lock and the water from the upper level flows in and fills the lock to the level of the upper reach. The upper gates are then opened in a similar manner to that described in connection with the opening of the lower gates, allowing the barge to proceed on its journey.

WIERS.

To keep the various levels of the canal normal, on account of excessive flow of water from above or any heavy draught of power used on a level or by lockages, the flow of water has to be compensated for by adjusting the wier gates. These gates are operated by worm and segment or in some cases by raising or lowering the valves in a manner similar to that on the lock gates, the operating of which is carried out in much the same way as described in connection with the gates.

As there are a number of wier gates or valves which must be capable of independent operation, provision is made by means of a double jaw clutch engaging with either one or the other of two bevel gears on a horizontal shaft which meshes into a third bevelled gear on a shaft of the worm for operating the segment which drives the valve stems. The operator only has to throw the clutch into engagement so as to move the valve in the desired direction, and as soon as the gate has opened or closed sufficiently for the purpose of regulation, the lever is thrown out of engagement with the gear. A friction clutch is placed between the shaft of the worm wheel driven by the motor so that in case of accident resulting in jamming any of the parts, the friction clutch will slip before any serious breakage occurs.

BRIDGES.

The equipment for the bridges is operated by a motor driving the mechanism through worm gears, the same power unit being utilized as for the operation of the lock gates and wiers, an extension of the interchangeable idea. Aside from the first speed reduction, however, the gearing is quite different, though in the case of both the Mille Roches and the Stormont bridges the arrangement is worked out on similar lines.

The bridge at Mille Roches is 179 feet x 12 feet and has the motor swung under the bridge just outside of the turn table, being counterbalanced by weights at the opposite end of the bridge. I beams support the motor and worm gear case, the shaft of which drives the gearing communicating the motion to a pinion meshing with the rack which turns the bridge. A friction clutch communicates the power from the motor driven worm shaft to one or the other of a pair of bevels, turning the bridge in whichever direction the operator desires. The clutches are operated by two removeable levers coming up through the bridge floor so that the bridge tender has ready control of both.

To swing the bridge, the operator first starts the motor, then throws the lever which withdraws the bolts, unlocking the bridge; one of the clutch levers is then operated so as to engage the bevel gear required to turn the bridge in the desired direction for opening. The friction slips for a while until it gets the bridge under motion, then it swings rapidly until it is nearly open, when the operator uses the other friction clutch (which tends to turn the bridge in the opposite direction) as a brake to retard the speed, and gradually bringing the bridge to rest in the open position. The reverse motion is used for closing and is operated in very much the same way.

The control of the Stormont bridge is very similar to that of the Mille Roches bridge, the only difference in the mechanism being that the power unit is mounted inside the drum of the turn table on I beam frame which does not require to be balanced. The power is communicated with a large intermediate gear so as to reach the gearing originally utilized in turning the bridge by hand.

The Stormont bridge is very much heavier than the Mille Roches bridge, but the operation is very satisfactory. The normal full load current is only exceeded for a few seconds in starting.

As in both cases the motors are mounted under the deck of the bridge, little protection is required, but a galvanized iron cover is provided so that drip from the underside of the planking is prevented from reaching the motors. The motors alongside the locks are also protected with easily removeable galvanized iron hoods or covers. This is the only protection from the weather which has been provided for the motors and they have been left in their position without any other cover for the last two winters.

The hardiness of the motor used has been well demonstrated by the fact that the motors start up every season without any trouble. The only serious trouble with the machines occurred after a heavy storm which brought the 11,000 volt primaries in contact with the 550 volt secondaries for a few seconds, resulting in a burn-out of half a dozen motor coils in one of the machines. Ligntning has occasionally given slight trouble but nothing of a very serious character has occurred.

DISCUSSION.

A discussion followed on the above paper, as well as on a paper presented the same evening by Prof. Herdt on "The Equipment of the Lachine Canal."

Prof. Herdt said that the principal advantage of using electricity on canals was the saving of labor. He did not wish to touch too closely on the financial side of the question, but the cost of the installation, with the interest on the money and putting aside 10 per cent. for depreciation, was about the same, leaving the lighting free. The capacity of a canal was practically duplicated, as it could be used as readily at night as in the day time, and the time required for opening the gates had been reduced from a minute and a half to one minute. On the Lachine canal the electrical equipment was not in use as yet, but the machinery was now being installed. He added that when the Montreal Light & Power Company were short of power, the Lachine power station furnished them with 150 kilowatts, running this station in multiple with the Power Company's stations.

Mr. Leonard said there had been some experiments made at the Cornwall Canal. Two men were placed on each winch and we endeavored to open the gate just as fast as we could. The men turned away at a pretty lively pace, a good deal faster than usual, and the gates were opened in just one minute and a half. The electric power was applied and the gates were opened in just about one minute. However, of course, the water had to be regulated, and if too much water is allowed to pass, damage might result, and the opening of the gate is the only way that time could be saved. We have also saved labor and reduced expenses. Instead of four men, but two are required, so that the 24 hours can be divided into two watches, giving the men some time to themselves, whereas formerly the four men were required to make the lockages and were on duty the whole twenty-four hours, catching sleep as best they could between times.

Mr. K. B. Thornton: Prof. Herdt's remarks as to the Montreal Light, Heat & Power Company using power from the Lachine Canal are quite true; we did use power from one of their machines for several months. We ran our series arc lighting from that station, by building a shanty on the bank of the canal and putting in three transformers and regulators, connecting one to each phase. We ran for several months in that way. There is one point on which I would like to question Mr. Leonard. I would like to know just how many lamps there were on each circuit on the Cornwall Canal, whether spark gaps on individual lamps or lightning arresters were used on the arc circuits and if they had any special trouble operating them, also whether they used absolute cut-outs on the lamps.

Mr. Leonard: The circuits ran from 20 to 100 lamps per circuit. I am not quite sure but think they have at the present time 85 to 90 lamps per circuit—in cases of trouble we have run with as high as 110 lamps on a circuit. This impresses a very high voltage on the line and the high voltage puts a severe strain on everything all the way round.

Mr. K. B. Thornton: That is just the trouble in series lighting that some of us have encountered. Would the placing of arresters on the line and spark gaps really reduce troubles in any way?

Mr. Leonard: We did not make any special provisions except to protect the cables at the point where they passed under the canal from one bank to another and at the piers of the bridges we had lightning arresters. We had a breakdown in one piece of cable, but it was cable which had been designed for 3,000 volts and temporarily used on 11,000 volts. Lightning arresters at the crossing seemed to have helped. We had lightning arresters at the station on each circuit and cut down the gaps one half, making the resistance to ground across the gaps that much lower. We had no trouble except the breaking down of the insulation in the arc lamps due to the excessive strain.

The Chairman asked Mr. Leonard if he had experienced any trouble with the friction clutches, on which the work would be very severe.

Mr. Leonard: We have had absolutely no trouble whatever from the friction clutches. In the case of these clutches, we provided liberal capacity, using a clutch pretty large for the work it had to do. The mechanism operates by the pressing up of two cast iron plates against another disk having wooden blocks inserted—the wood wearing on the ends. The clutches will slip under a certain pressure, and this is done in the operation of checking and reversing the bridge. The bridge starts up slowly, comes up to full speed, and then swings into place, slowing down and coming to rest as nicely as can be desired.

Mr. Thornton: Mr. Leonard said the pins were boiled in steric acid. I would like to know what kind of wood was used and whether the pins were put in steric acid for insulating or preserving purposes. When the line was built from Chambly to Montreal, the pins were boiled for several hours in paraffine. Careful observations have shown that the paraffine has evaporated to a great extent and it is a question whether it pays to treat the pins at all.

Mr. Leonard: The difference petween paraffine and steric acid is that paraffine exposed to the sun will evaporate. Steric acid dries very hard, like the wax on this match I hold in my hand, and holds its body well. It stands the weather and at the same time forms a good coating, which is an insulator and works very well. Most of the pins were hickory. Our supply ran out and we used some locust pins—they were all treated in the same way, boiled in steric acid for perhaps half an hour. It seems to fill the pores of the pin. Steric acid is a good preservative and a good insulator at the same time.

Mr. Walbank asked Prof. Herdt if he had any idea what the cost of maintenance was for the arc lamps along the Lachine Canal.

Prof. Herdt stated that this had not been figured out yet, that the lamps had not been in operation a sufficient length of time. According to the reports of the inspectors, there were on an average 99 lamps burning out of a hundred every night. He stated that he had gone over the circuits many times personally and that they had had very little trouble with their arc lamps.

Mr. Walbank: How is that compared with the Cornwall Canal?

Mr. Leonard: As I have already stated, we have had some trouble with the 10,000 volt circuits. Those on the Lachine Canal are operated at 2400 volts only.

The Chairman: What series transformers are you using?

Prof. Herdt: Floating coil.

Mr. Walbank: At Cornwall the G. I. is used.

The Chairman: There is another feature of the application of electricity to canal service which I think will have to be taken up next year, that is, towing. It is a most important point, although I believe it has not yet been gone into much on this side, though it has in Europe. There are some experiments being made now in the States, and if they make as much of it as has been done in Europe, we may see an extension of the present plants.

Mr. Leonard: We did a little experimenting with the question of towing on the Cornwall Canal. We put a 40 h. p. motor on a gypsy winch and tried pulling some barges in, and we got the government yacht "Alert" to get on a full head of steam, and we pulled her right into the lock while she was pulling against us at full speed. We were experimenting with a view to using winches for pulling boats into the locks instead of allowing them to enter under their own steam, so as to prevent their going through the gates in case of anything happening to their reversing gear. To provide against that danger, they proposed winches at all the locks, warping them into the lock instead of allowing them to go through with their own steam. Towing electrically certainly promises to be a very interesting question, but as Mr. Ross has stated, it is a problem which has not been gone into very extensively on this side as yet.

The Canadian Westinghouse Company have been awarded the contract by the Dominion Government for 552 7.5 ampere series enclosed alternating current arc lamps, with seven 75-light 7.5 ampere series automatic regulating constant current transformers for operation on 2000 volts, 60-cycle current, and eleven switchboard panels, with all the necessary instruments mounted thereon, for the lighting of the Welland Canal. The above contract represents a consideration in the neighborhood of $25,000. The Canadian General Electric Company will supply independent arc lamp "cut outs" and one testing transformer, while the Packard Electric Company will furnish the reactance type regulators and constant potential transformers.

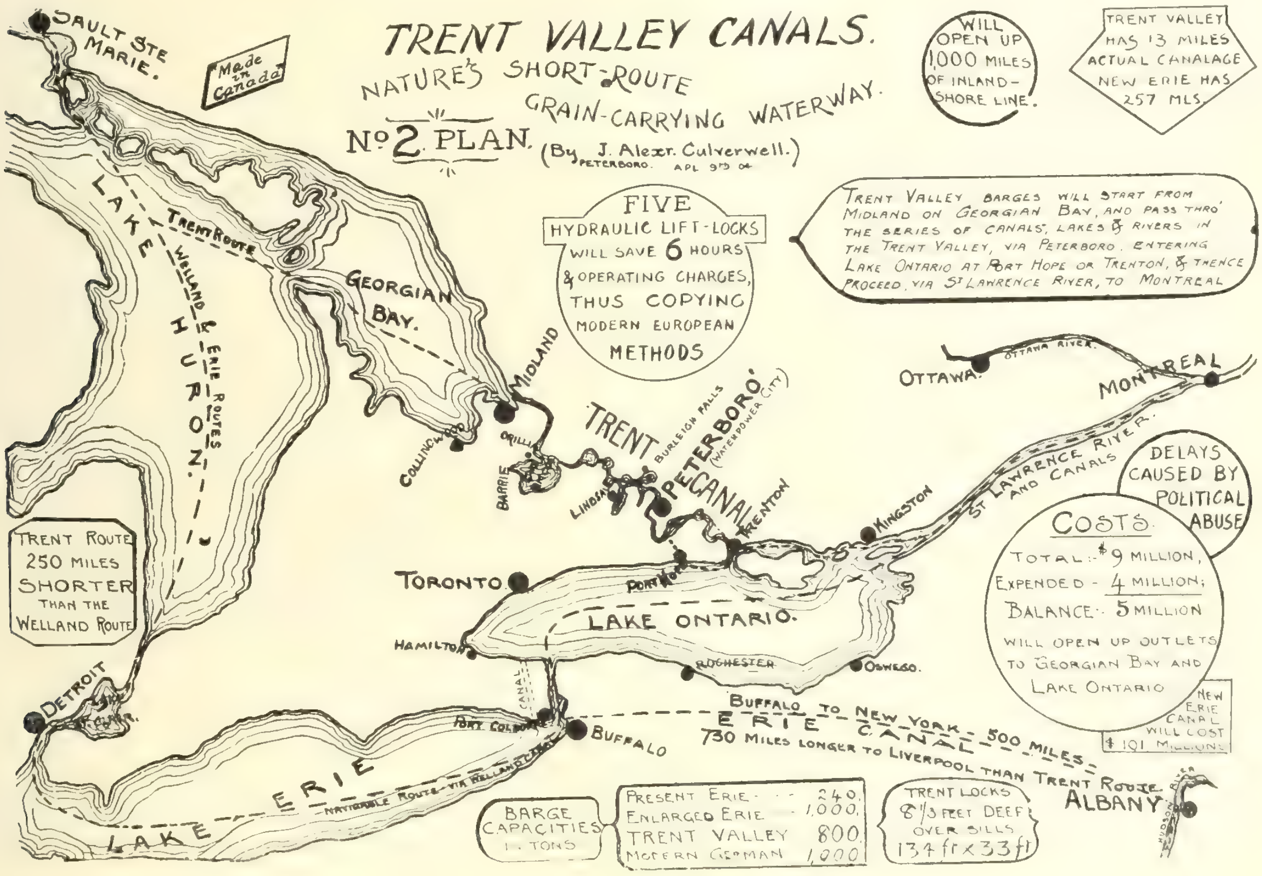
TRENT VALLEY CANAL.

By J. Alex'r Culverwell, of Peterboro'.

What a remarkable situation for Canadians to waken up to—that at this late day they discover the Trent Valley Canal has followed out the same method adopted in the $100,000,000 modern German canal system connecting the coal and steel districts with the North Sea, viz., length and breadth of lock rather than depth.

The draught of the German barges is 7⅓ feet and capacity 1,000 tons. The dimensions of the Trent Valley locks are 134 feet long by 33 feet wide, with a depth of 8 feet 4 inches on the sill, as per departmental instructions. The locks will accommodate barges of 800 tons or 25,000 bushels, and the total cost of the work will be $9,000,000.

The present Erie Canal, which has a capacity for only 240 ton barges, is now being enlarged by New York State at a cost of $100,000,000 to accommodate barges of 1,000 tons, 150 feet long, 25 feet wide, and having ten feet draught—the depth on lock sills being 11 feet, and the depth in the canal reach 12 feet.


TRENT VALLEY CANALS.
NATURE'S SHORT-ROUTE GRAIN-CARRYING WATERWAY.
No 2 PLAN.
(By J. Alexr. Culverwell.) PETERBORO. APL 9th 04
Made in Canada
WILL OPEN UP 1,000 MILES OF INLAND-SHORE LINE.
TRENT VALLEY HAS 13 MILES ACTUAL CANALAGE NEW ERIE HAS 257 MLS.
FIVE HYDRAULIC LIFT-LOCKS WILL SAVE 6 HOURS & OPERATING CHARGES, THUS COPYING MODERN EUROPEAN METHODS
TRENT VALLEY BARGES WILL START FROM MIDLAND ON GEORGIAN BAY, AND PASS THRO' THE SERIES OF CANALS, LAKES & RIVERS IN THE TRENT VALLEY, VIA PETERBORO. ENTERING LAKE ONTARIO AT PORT HOPE OR TRENTON, & THENCE PROCEED, VIA ST LAWRENCE RIVER, TO MONTREAL
SAULT STE MARIE.
LAKE HURON.
TRENT ROUTE
WELLAND & ERIE ROUTES
GEORGIAN BAY.
MIDLAND
COLLINGWOOD
ORILLIA
BARRIE
LINDSAY
TRENT CANAL
BURLEIGH FALLS
PETERBORO. (WATERPOWER CITY)
TRENTON
OTTAWA.
OTTAWA RIVER.
MONTREAL
KINGSTON
ST LAWRENCE RIVER AND CANALS
DELAYS CAUSED BY POLITICAL ABUSE
COSTS. TOTAL:- $9 MILLION, EXPENDED - 4 MILLION; BALANCE - 5 MILLION WILL OPEN UP OUTLETS TO GEORGIAN BAY AND LAKE ONTARIO
NEW ERIE CANAL WILL COST $101 MILLIONS
TRENT ROUTE 250 MILES SHORTER THAN THE WELLAND ROUTE
TORONTO.
PORT HOPE
LAKE ONTARIO.
HAMILTON
ROCHESTER
OSWEGO.
CANAL
PORT COLBORNE
BUFFALO
DETROIT
L. ST. CLAIR.
LAKE ERIE
NAVIGABLE ROUTE VIA WELLAND CANAL
BUFFALO TO NEW YORK - 500 MILES
ERIE CANAL
730 MILES LONGER TO LIVERPOOL THAN TRENT ROUTE.
ALBANY
HUDSON RIVER
BARGE CAPACITIES IN TONS
PRESENT ERIE - - - 240.
ENLARGED ERIE - 1,000.
TRENT VALLEY 800.
MODERN GERMAN 1,000
TRENT LOCKS 8⅓ FEET DEEP OVER SILLS 134 ft x 33 ft

The work of the Trent Valley Canal was originally commenced by the Imperial Government in 1825, but the money voted was diverted to quell the Mackenzie rebellion. Construction was again started in 1880 by the Dominion Government and has been dragging along until now. Nearly $4,000,000 has been expended, and this season construction will have been completed between Lake Couchiching—an arm of Lake Simcoe—on the north, and Rice Lake on the south. The balance, viz., $5,000,000, would open up the two outlets, the northern outlet between Midland on Georgian Bay and Orillia on Lake Simcoe, and the southern outlet between Rice Lake and Lake Ontario, either at Port Hope or Trenton. This waterway would then open up about 1,000 miles of inland shore line, as many of the lakes and rivers lie transversely to the line of the canal.

In its national work of utility, the Trent Valley Canal and waterway will connect Georgian Bay at Midland, where the great lake carriers will discharge the North-West grain into the Trent Valley barges, which, passing through this series of connecting short canals, lakes and rivers, via Peterboro', will enter Lake Ontario at Port Hope or Trenton, and thence proceed by the St. Lawrence river and canals to the city of Montreal, where they will discharge into the ocean carriers for Europe. The old 9-foot system of St. Lawrence canals, which are still in existence, can be used by the Trent Valley barges, which therefore will not need to crowd up the new 14-foot St. Lawrence ship canal system—a great advantage.

Cheap power and cheap transportation are the two principal factors of the cost of manufacture, and with such advantages as the cheap power now offering at Peterboro' and also offered elsewhere on the canal, it does not take a Rothschild to see as he did in 1898 and make the statement that "This district is destined to become one of the great manufacturing centres of the continent." Surely it must be admitted the possibilities of this district are that it will become a great industrial bee-hive, and that Midland and other towns on the Georgian Bay, as well as Orillia, Barrie, Lindsay, and Peterboro' on the line of canal, will be simply feeders to the trade and prosperity of Toronto and Hamilton, as well as points east and Montreal, and here it may well be noted that the manufacturing development at Peterboro', in particular, has been remarkable indeed the past three years.

The great lumber regions on the shore of the Georgian Bay can be tapped by the Trent Valley barges. I would look to see also the canal district becoming an iron centre through Lake Superior ore being brought into close touch by the opening of the canal—as by reason of the shorter distance the upper lake steamers could make three trips to the canal port in the same time as would be consumed for only two trips to Buffalo. Here it may be stated that the Welland route between the Soo and Montreal will be a day longer, or two days in the return trip, than by the Trent Valley route. The Trent route between the Soo and Liverpool is shorter altogether by 730 miles, or nearly 1,500 in the return trip, than by the Erie route.

At Peterboro' the hydraulic lift-lock is now about completed, while a second one, a lower lift, which is located near Lake Simcoe, is well on to completion. Nature has indeed repeated itself five times in different locations on this waterway, adapting herself for the use of the great hydraulic lift-locks—which together will save about six hours over the ordinary system of locking as used on the Welland and Erie canals. The Peterboro' hydraulic lift-lock will lift these 25,000 bushel barges from the lower level of the canal 65 feet up to the higher level, or vice versa, by means of two immense steel pontoons. These pontoons are closed at their ends by means of gates, hung on the lower edges, and gates being also used to close the ends of the reaches of the canal on the upper and lower levels. These pontoons, guided between three massive concrete towers, are each supported on top of the steel pistons 7½ feet in diameter, which work in watertight steel wells one under each piston. Each pontoon is simultaneously up and down.

The canal, on the level above the Peterboro' lift-lock, starts at Nassau, where it is diverted from the river Otonabee, and is carried along the high table and parallel with the river for four miles, and is lowered by means of the lift-lock into the river below, at Peterboro'.

This hydraulic lift-lock simply copies the method adopted in the modern European canal, and its use was recommended by Frank Turner, C.E., who was one of the Canadian Government Commission of 1887, associated with John Kennedy, C.E., harbor engineer of Montreal, and Judge Weller, of Peterboro'. This Commission, it is well to add, reported favorably on the Trent Valley Canal both as to its water supply, feasibility and utility, and advised its completion.

A number of hydraulic lift-locks have been in successful use in Europe for some years. The lock at Cake LesFontinettes, in France, replaced six ordinary connecting locks, thus reducing the time as well as operating charges. The new German lock lifts a 1,000 ton barge, while the Peterboro lifts an 800 ton barge.

Detailed figures as to probable cost of carriage by Trent Valley steam-barge with several tow-barges in consort between Midland and Montreal were submitted to the Royal Commission on Transportation at their recent sitting at Peterboro' by practical marine men, which well bear out my previously repeated contentions that grain could be shipped via Trent Valley in a much shorter time and at a cheaper rate than via the new Enlarged Erie route, notwithstanding the Enlarged Erie locks will accommodate two barges in tandem. Here it must not be forgotten that the Trent Valley expenditure will only total $9,000,000 as against a total of $158,000,000 which is the cost of the present canal together with the proposed enlargement. The Trent Valley locks can also be duplicated at a small comparative cost, thus further shortening the time of a fleet of barges and cheapening the rate over the Enlarged Erie, as also enlarging the total tonnage of the canal. Surely anyone should see at a glance the superiority of the Trent Valley route over the Enlarged Erie when it is noted that there will be 257 miles of actual standard canalage and 233 miles of river and lake on the new Erie between Buffalo and New York, while there will be only 13 miles actual standard canalage on the Trent Valley and 45 miles on the St. Lawrence canals, or a total of 58 miles of canalage and 411 miles of river and lake between Midland and Montreal.

The late Mr. E. Sweet, C.E., State Engineer of New York, has shown by experiments that the same power that will propel a barge 4 miles per hour in Erie standard canalage will drive a barge 5.9 miles per hour in open water—this feature alone will cause a great saving both in time and in coal consumption on the Trent Valley over the Enlarged Erie.

Certain marine men are clamoring the Government to enlarge the Welland Canal, to enable 6,000 ton boats to pass on to Kingston, making necessary a 21 foot channel, and doubling the length of locks—the idea being to discharge at Kingston into 2,000 ton barges. This request was made just after $40,000,000 had been spent on enlarging the Welland-St. Lawrence route from 9 to 14 feet. I advocate, first, the spending of the five millions necessary to complete the outlets of the Trent Valley Canal, and would point out the fact that marine experts writing in American journals have stated that the only Canadian route they feared was the barge route through the Trent Valley, which, as they express it, was simply a connecting up of lakes and rivers. "The grain-hopper is full but the spout is small."

FAVORS THE METER SYSTEM.

Mr. William Snider, owner of the electric light and power plant at Waterloo, Ont., has decided to adopt the meter system entirely for the sale of current. Concerning the relative merits of the meter and flat rate systems Mr. Snider writes to the ELECTRICAL NEWS as follows: "We have for some time been lighting private houses on the meter system, but business places have been mostly on flat rate. I find the latter very unsatisfactory and have decided the only fair way to myself as well as to customers is the meter rate, in which case consumers pay for what they use. I find there is an immense waste of power where flat rates are charged and nobody derives any benefit therefrom. By meter rate anyone that wishes to be economical can have all the conveniences, and have reasonable lighting expenses, and those who are anxious to have their premises lighted up well can have it by paying for it. It takes a little time and explanation to get people to understand why they should not be supplied on a flat rate, but any reasonable person can see that no electric light, gas or water plant can afford to have taps open all day when they are only paid for a couple of hours."

The International Telephone Company have decided to establish telephone connection between Victoria, B.C., and the mainland. The cable is to be four-ply and will be laid by San Juan, Orca and Lummi island to Watcom. It is understood that a rate of 50 cents will be charged for a one-minute conversation wiht Vancouver and 60 cents to Seattle.

THE LATE MR. LYMAN P. DWIGHT.

The death of Mr. Lyman P. Dwight, superintendent of the Great Northwestern Telegraph Company, Winnipeg, and only son of Mr. H. P. Dwight, of this city, president of the same company, cut short a life which was full of promise. He was only forty years of age and up to about two years ago was possessed of great vigor. Recently he was troubled with an obstinate bronchial affection. Just before Christmas his illness became more serious, and he had since been confined to his house. Occasionally he would appear much improved and his condition would inspire hopes of ultimate recovery, but he finally succumbed.

Mr. Dwight was born in Toronto and was educated at Dr. Tasse's Collegiate Institute at Galt and at the Upper Canada College at Toronto. Upon leaving college he joined the Great Northwestern Telegraph Company and after filling various positions was appointed local manager at Toronto, which position he held until 1889, when he was appointed superintendent at Winnipeg, with full charge of the company's wires in the North-West. Mr. Dwight showed exceptional ability and under his management the business at Winnipeg increased very rapidly. During his fifteen years' residence there, the place grew from a comparatively small town to a large and prosperous city. He had a thorough grasp of telegraphic matters, particularly as regards the requirements of the North-West, and planned accordingly.

The Late Mr. Lyman P. Dwight.

Besides being highly popular with the general public, owing to his cheerful disposition, Mr. Dwight enjoyed the unbounded respect and esteem of his confreres of the telegraph. When a young man he was a devotee of lacrosse and other amateur sports, and was one of a lacrosse team which in 1883 visited England to play exhibition and match games. It is said that this was probably the best all-round team of stick-handlers ever organized in Canada. Mr. Dwight did not return with the team, but remained abroad a couple of months, visiting Paris, Berlin, and other centres of interest.

Shortly after moving to Winnipeg Mr. Dwight married Miss Kate Laidlaw, daughter of the late George Laidlaw, the well-known promoter of narrow gauge railways. Mrs. Dwight survives her husband.

POWER PLANT OF THE C. P. R. SHOPS.

In the January issue of the Electrical News particulars were given of the electric installation at the new C. P. R. shops in Montreal. Below will be found a description of the power plant :

The 100x160-foot power building is divided by a longitudinal center wall into a boiler room and an engine room. In the boiler room are four 416-horse-power Babcock & Wilcox boilers for a working pressure of 150 pounds, and one 300-horse-power boiler of the same make for a pressure of 300 pounds to be used in testing locomotives. These boilers are equipped with Neemes's shaking grates and are stoked by hand, but there is also a shavings exhaust system for supplying the boilers with refuse from the planing mill. The induced draught system is operated by two 10-foot Sturtevant fans which make about 200 revolutions per minute and are connected with a steel stack 8 feet in diameter and 70 feet high. Two Green economizers of sufficient rated capacity to serve the five boilers have been installed, and provision is made for the future installation of three more boilers of 416-horse-power each. All the boilers are connected to a 12-inch header, and reducing valves and a by-pass are provided to permit the steam at 300 pounds pressure to be used with the low-pressure battery when the high pressure is not required for testing purposes. Two 12x7x12-inch Northey feed-water pumps built by the Canada Foundry Company, Toronto, have been put in for the 416-horse-power boilers and two 6x3½x6-inch Worthington feed-water pumps for the 150-horse-power boiler. There is also a feed-water heater, made by the Goubert Manufacturing Company, New York, of sufficient capacity for all the boilers.

The ashes are discharged to floor hoppers, from which they are emptied at convenience into cars in a tunnel running beneath the boiler house and terminating at an air hoist for lifting the dump cars to the surface tracks, on which they are run to the spoil banks.

In the engine room there are three 750-horse-power and one 375-horse-power cross-compound horizontal Corliss engines, making 150 r. p. m., built by the Tobb Engineering Company, Amherst, Nova Scotia, direct-connected to three 500-kilowatt and one 250-kilowatt three-phase 300-volt alternating-current generators. Besides these generators there are two 250-kilowatt 250-volt direct-current dynamos for the crane service. The alternating-current generators, motors for some of the tools and the exciters were built by the Canadian General Electric Company. Air is compressed by machines brought from the old shops and is delivered at 100 pounds pressure through a 7-inch and a 2-inch main leading to the different parts of the plant and connected to one or more receivers in each of the buildings. The engine house is served by a 10-ton traveling crane built by the Whiting Foundry Equipment Company.

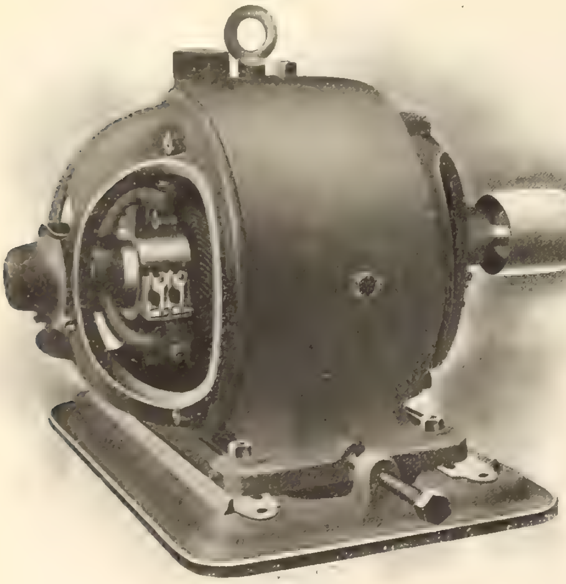
A tunnel from the power house was run to most of the important buildings, and carries on wall brackets the live steam pipe for heating at night, an exhaust steam pipe for heating by day, a high-pressure steam pipe for locomotive tests, air pipes for pneumatic service and a return pipe for the drainage of all the heating apparatus, the condensation water from which is saved and used again. All steam and exhaust pipes are jacketed with asbestos air-cell covering wired on.

THE "R. E." TYPE OF MOTOR.

The Rhodes Electrical Manufacturing Company, Limited, of London, Eng., who are one of the most up-to-date manufacturers of electric power motors in the world, shortly intend opening branch offices in the Dominion for the sale of their machines. This company have manufactured up till now only direct current machines, viz., their R.E. type motor, and a description of this machine will no doubt be interesting to readers of this journal.

One of the salient features of the business of this firm is their extremely quick delivery; they guarantee in this type of machine to deliver f.o.b. English port, any size or any speed machine coming within the range they manufacture within 10 days from receipt of order. Their splendid works organization enables them to do this. This system of quick delivery, together with their enterprise and push, has placed them ahead of many of their competitors in the United Kingdom. They specialize on one class of manufacture, and that a thoroughly commercial proposition, with the result that they have been doubling their output every three months during the last two years.

The R. E. type motor is a thorough mechanically constructed machine, as well as having a high electrical efficiency. The armature is built up of former wound coils on a laminated toothed core. The coils are firmly secured in position by steel bands and any individual coil can be removed or replaced with ease. The cummutator is composed of best hard drawn copper segments, insulated with pure mica and assembed under hydraulic pressure to ensure absolute solidity. The frame, which also forms the magnet yoke, is of high permeability iron or steel, and the pole cores, circular in shape, are of annealed wrought iron, or high permeability steel, fitted with extended laminated pole tips, encircling a large proportion of the armature surface. The field coils are also former wound, and the bearings, which are of soild gun metal, and the brush gears are of up-to-date design. It is interesting to note that the makers have succeeded in eliminating the humming sound usually emitted by motors and other electrical machinery when running. The motors are thoroughly tested, both for full and overload running, over a considerable period and for insulation, a high pressure test of 2,500 volts being given between the windings and the frame.



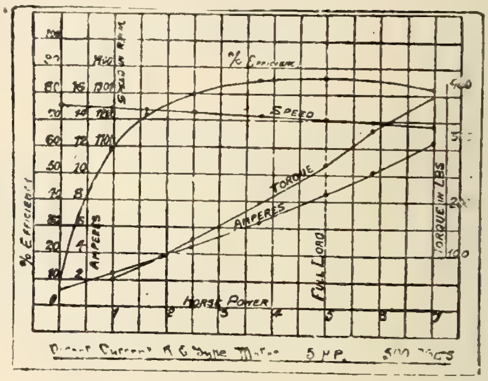
THE "R.E." MOTOR—RHODES ELECTRICAL MFG. CO.

The machine itself is specially adapted for export, inasmuch as it has few parts and those all interchangeable. The fact that this firm do not cramp their machines in any way permits of heavy over-loads with a low temperature rise. The bearings, which are of self-aligning type, are gun metal and are lubricated automatically, and finally, the appearance as regards beauty of design is decidedly pleasing.

Special care is paid to the packing of the machines so as to avoid any breakages during trans-shipment. The cases are constructed to take each size motor with practically no side or end play at all and by means of struss fixed in different positions it makes it impossible for the motor to sustain any damage through rough handling. At the same time, the firm include, if it is desired, a few extra spare parts in case of accidents, which can be easily utilized if required.

With regard to the prices at which they supply their machines. As it is their intention to secure part of the trade in Canada, would-be purchasers of English made machines should have no qualms to write to them for quotations, as they claim to be willing to meet any competition. It is intended shortly to keep stocks of suitable sizes and voltages here in Canada.

The company for the last few months have been experimenting with alternating current machines and they will shortly place on the market three distinct types of alternating current motors, for single, two and three-phase currents; it is their intention, as soon as they have standardized these machines, to supply as good a machine and effect as prompt deliveries as in the case of their R. E. direct current motors.



The different types of alternating current motors which at the present moment they are building are: (1) A short-circuited rotor machine, of the squirrel cage type, single, two and three phase, up to 5 h.p., will be called their "R S" type. (2) A hand wound rotor with slip rings, for single, two and three phase, to be known as their "R H" type, the single phase motor starting up as a split phase motor. (3) Their "R F" type motor, a single phase alternating current machine with a very powerful starting torque, which is intended to be used in conjunction with lifts and so forth, and will operate in as satisfactory a manner as far as starting is concerned as a direct current machine. The normal starting current with a full load torque will not exceed full load running current, consequently this will meet public supply companies' regulations. The type of this machine will be that of a repulsion and induction motor combined. Here again the price, delivery and quality of the machine will no doubt be all that can be desired.

SPARKS.

The Electric Railway and Light Commissioners of Port Arthur, Ont., have decided to install a storage battery plant in the municipal power house.

The Hamilton Motor Works, Limited, of Hamilton, has been incorporated, with a capital of $40,000, the provisional directors being W. C. G. Smart, J. A. Turner and W. A. Logie.

It is understood to be the intention of the Calgary Water Power Company, of which Mr. John E. Prince is manager, to erect a new fire-proof building in the near future. The company are now installing new dynamos, engines and boilers.

The People's Light & Power Company, of Fredericton, N.B., have elected the following officers: President, T. C. Allen, K.C.; vice-president, W. T. Chestnut; secretary-treasurer, W. B. Winslow. It is the intention to proceed at once with the installation of their plant.

A number of Toronto gentlemen, including Messrs. Joseph Kilgour, Hamilton Cassels, R. S. Cassels, and W. H. Langlois, with Mr. G. T. Marks, of Port Arthur, have formed the Current River Power Company, to develop a water power situate in the township of Sanniah, near Port Arthur.

The British Columbia Electric Railway Company are about to call for tenders for the erection of a new sub-station in New Westminster, which will be used for the transforming of the high potential electric current at the Trout Lake power house to the voltage used for commercial purposes. The station will be 33x60 feet, and built of concrete, stone, and steel. It is estimated to cost $13,000.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, April 9th, 1904.

It is said that the Montreal Light, Heat & Power Company will shortly begin the work of consolidating the old "Royal" and "Lachine" distribution systems, after which presumably all power from Lachine will be transmitted to the sub-station of the M.L.H. & P. Company, as well as that now being transmitted from Chambly, for distribution.

Early this month there was considerable excitement at the town of Joliette, P.Q., through which passes the 55,000 volt transmission lines from Shawinigan Falls to Montreal. The trouble was said to have been caused by the breaking of one of the aluminum conductors and its falling on a private telephone wire of the company's, strung on the same poles. The current was shut off from their Montreal "step-down" station for some hours, during which time the M.L.H. & P. Company, lessees of the Shawinigan power, took charge of that portion of the load from their other station, so that the section of the city fed from Shawinigan was but temporarily inconvenienced. Incipient fires were also reported from Joliette, one of the places affected being the C.P.R. station there, which suffered some damage. Repairs to the transmission line were quickly made and current turned on again with a few hours delay. This trouble, coupled with the fact that an employee was lately killed there by coming in contact with the live wires in the "step-down" station, would lead some to think there was a mild form of "hoodoo" lurking around.

Out of the 88 aspirants for Electrical Contractor honors in the City of Montreal, it is expected that this year will see a much needed clearance. There are far too many for the city's needs, and the business is cut until there is virtually no profit in it. The new high rates for electric lighting in residences, etc., also for power, are cutting down wiring considerably. People are not rushing to wire their houses as in former years, and as work is not so plentiful it will be a case of the survival of the fittest among some contractors.

Trade in the electrical line has been duller during the past hard winter than for some years. Both supply dealers and contractors have found it getting worse and worse ever since New Years, and it is only with the beginning of April that it is now beginning t [illegible] somewhat.

With the exception of the first good snow-storm which invariably knocks them out, the Montreal Street Railway have done nobly this winter. In January alone snow fell on 21 days, and other months added their quota of snow and severe cold, through all of which the Street Railway have maintained an excellent service and deserve the highest praise for their hard work.

The Eugene F. Phillips Company will build their large new factory at St. Louis du Mile End, the north-east suburb of Montreal. It is not yet decided whether or not electric power will be used. The new premises will be much larger than their present buildings, which will be entirely vacated.

The extensive addition to the Wire and Cable Company's factory on Guy Street is progressing rapidly. It is said that the firm will devote a good space to "weatherproof" wire manufacture and enter that field.

Jack Clegg, of the Montreal Light, Heat and Power Company, has severed his connection with that company to take charge of the switchboard at the Academy of Music, in fact will supervise the electrical arrangements in all theatres under the control of the Sparrow syndicate in Montreal. The selection of such a man is the outcome of the Iroquois Theatre disaster. Mr. Clegg was one of the oldest employees in the M. L. H. & P. Company, having joined the old Royal Electric Company many years ago. He was foreman of the interior wiring department, and is capable, steady, and trustworthy.

The Montreal Light, Heat & Power Company have given notice to electrical contractors in Montreal that they will in future refuse to make connections with 50 and 104 volt systems and that in future all connections will be made at the uniform voltage of 110 volts. In the early days the Royal Electric Company operated at 50 volts, later on this voltage was doubled, giving a system of 104 volts. Both voltages have been used up to the present, but with the recent amalgamation of the electrical interests it has been decided to establish for the future a uniform voltage. Notice has been given contractors that in the future the Montreal Light, Heat & Power Company will decline to make connections in the rear of buildings necessitating the carrying of wires over roofs and in future all connections must be made at the front of the building. This decision is partly due to the many actions for damages brought against the company and which have been the result of interference of roofers and others with wires passing over roofs of buildings. It is the intention of the company to extend at as early a date as possible the underground system commenced by the Lachine Rapids Hydraulic & Land Company. In all probability a vitrified clay conduit will be used to enclose the wires, but it has not yet been decided whether a single multiplex or duplex conduit will be employed. It is also the intention to operate the various power stations on the three-phase system.

A solid job has apparently been made at the Chambly dam, as with portions of a railway bridge and a foot bridge against it, as well as tons of ice and a regular freshet, everything held. Concrete dams have had a bad black eye; the former dam was of that variety and was washed away like quite a few similar ones The present dam is well filled crib work.

Owning to continued ill-health Mr. John Shaw will on May 1st retire from partnership in the Montreal Electric Company. The business will be continued as heretofore by Mr. W. B. Shaw.

MONO-RAILROADS.

There is about to be constructed between Manchester and Liverpool an electric express mono-rail track, which will be the pioneer high-speed railway in the world. The length of the line will be a little over 34 miles, and the cars will cover the distance in twenty minutes, giving a speed of 110 miles per hour. The patentee of this system, Mr. F. B. Behr, has devoted many years to this form of travel. At the Brussels Exhibition he built an experimental mono-rail, on which very high speeds were attained.

The earlier mono-rails built by Mr. Behr were steam line and many of these exist in various parts of the world and give every satisfaction. Engineers are agreed that average speeds of seventy miles an hour are impossible on curves found on the existing railways. The construction of a special mono-rail track would enable very high speeds to be reached with perfect safety. It would be constructed alongside the existing railroad, or the cars could be run overhead.

NEW RADIAL ELECTRIC RAILWAY SYSTEM.

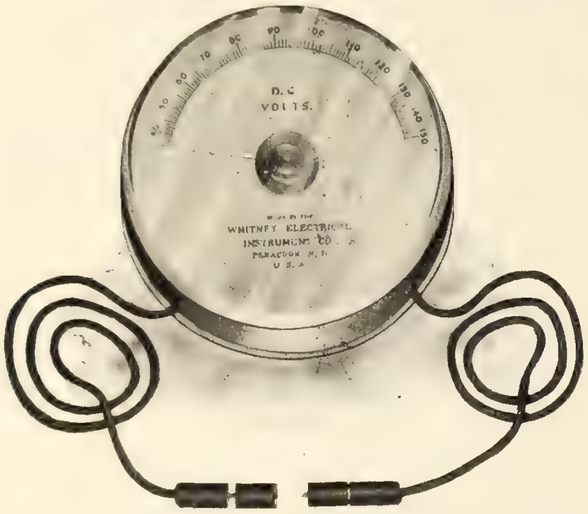
Mr. A.E. Welch, managing director of the South-Western Traction Company, recently returned from England, where he succeeded in having the bonds of the company floated by an English syndicate. Some of the money now lies to the credit of the company in the Canadian Bank of Commerce at London, Ont., and additional money will be received as required. This assures the construction of a system of radial electric railways through the rich district in Western Ontario of which London is the center. The proposed route is as follows: London to Hamilton via Ingersoll, Woodstock and Brantford; London to Port Stanley via St. Thomas; St. Thomas to Aylmer; London to Strathroy via Delaware; Delaware to Glencoe.

The permanent way is almost completed as far as Lambeth Junction and surveyors are now at work on the line south from Lambeth to St. Thomas. Contracts for the permanent way construction have been let to the Midland Construction Company, of London, Ont., who will probably call for tenders immediately for the bridging, grading, and supplies. The contract for the electrical equipment, incluning power house and rolling stock, has been awarded to Bruce Peebles & Company, Limited, of Edinburgh, Scotland.

The directors and officials of the South-Western Traction Company are: President, F. G. Rumball, London, Ont.; vice president, Lieut-Col. Robert McEwen, Byron, Ont.; managing director and secretary treasurer, A. E. Welch, London, Ont; director and solicitor, T. H. Luscombe; directors, Dr. A. McKay, Ingersoll, Ont.; G. C. Elliott, Appin, Ont.; Capt. T. E. Robson, London, Ont.; H. M. Rumball, London, Eng.

POCKET VOLT AND AMMETERS.

Mr. C. E. Shedrick, of Sherbrooke, Que., general agent for Canada of the Whitney Electrical Instrument Company, has placed on the market a new coat pocket lineman's volt and ammeter, shown by the accompanying illustration. The diameter of the instrument is 4 inches, thickness 1⅛ inches, and weight 22 ounces. The volt meters range from 3 to 300 volts and the ammeters from 1 to 25 amperes. The small dimensions and light weight of these instruments, together with the fact that there is a compartment in the rear of the case for the cord terminals, make them most convenient to carry around in a coat pocket. The terminals of these instruments are a novel form of hard rubber binding posts from the ends of which metallic points project slightly, thus enabling one to take readings by merely pressing the ends against bus-bars, switch blades, or other exposed conductors. They are long enough so that it is possible to insert one of them in a lamp socket making contact with the centre connection without any chance of a short circuit, and the other terminal can then be pressed on the outer socket ring, thus giving you readings of the line voltage without necessitating the use of an attachment plug and cord. The terminals are also arranged so that they can be used like an ordinary binding post.



POCKET VOLT AND AMMETER.

"ANYUN" OIL FUSES.

We wish to call attention to the advertisement of "Anyun" high voltage oil fuses which appears on page 77 of this issue. The fuse consists of a glass tube with outwardly flanged ends, hard black fibre collars and caps, brass rods, nuts and terminals, air gaps, fuse links, and rubber discs and washers. At the top are air tubes, which also serve for the introduction of the oil.

The glass tube is partly filled with a high grade of transformer oil, which is poured in through one of the air pipes, just enough oil being used to completely submerge the fuse wire. When a short circuit occurs the oil enters the space between the two ends of the broken fuse wire, and effectually smothers any arc. The oil becomes darkened after a short circuit, the discoloration being caused by gases, but resumes its natural color after standing some time. Rubber discs and washers allow expansion and contraction of the glass, and prevent the oil from leaking out. The air space between the surface of the oil and the upper cap allows the oil to rise in the case of a very severe short circuit, and reduces the amount of pressure against the glass, which is very thick and tough, the air pipes allowing the gases to escape. The fuse is self-indicating, the fuse wire being visible until a short circuit occurs, which, as stated above, is manifested by the discoloration of the oil. A fuse can be refilled at the power house as often as it blows out, thus practically eliminating any further expense after the fuse has once been installed. This fuse is manufactured and sold, exclusively, by The Hill Electric Switch Company, Limited, of 426 St. Paul Street, Montreal, who have the sole right to manufacture and sell the same in the Dominion and in Newfoundland.

The Sunbeam Incandescent Lamp Company, of Toronto, have secured the contract to supply 10,000 lamps of 8, 16 and 32 candle power to the corporation of Berlin, Ont.

THE "G.E." TRADE MARK.

A trade mark ruling has recently been rendered by the Circuit Court of the United States for the Massachusetts district which confirms the right of the General Electric Company to exclusive use of its mark "G.E." on electric lamps. It was claimed that this mark was so placed on the stem of the lamp that no company could obliterate it in remaking the lamp, and that under color of a suit for the protection of a trade mark the General Electric Company was in reality seeking to destroy the business of a company remaking such lamps. The court decided that it was perfectly possible to remake such a lamp and obliterate the trade mark, and that when this is done the lamp is no longer a General Electric lamp. But if the remaking is done by any other company than the General Electric Company and the trade mark is not obliterated, the latter is then in use on an article where it does not belong. The court has accordingly granted an injunction against any such practice. The justness of this decision is evident to all who will stop to consider what a trade mark signifies, and in some respects the opinion is as important as the noted ruling which confirmed the Babcock & Wilcox Company's exclusive right to the use of its name in connection with water-tube boilers.

CONSOLIDATION OF OIL COMPANIES.

The Ontario Gazette announces the amalgamation of the Grant-Hamilton Oil Company, of Toronto, and the Canadian Oil Company, the Canadian Consolidated Company, and the Sun Oil Manufacturing Company, of Hamilton. The name is the Canadian Consolidated Oil Company, and the capital stock is placed at $15,000,000. The provisional directors are Messrs. J. Kerr, Petrolea ; E. R. Clarkson, T. Ramsey and L. Bauer, Hamilton; D. B. Hanna, J. J. Main, W. D. Lummis, T. H. Hamilton, Joseph Wright and W. P. Bull, Toronto ; W. J. Lovering, Coldwater ; J. Playfair, Midland ; W. J. Sheppard, Waubaushene ; W. Irwin and R. R. Hall, Peterboro. The head office is in Toronto. It is stated that four other companies are expected to join the amalgamation, namely : The Gall-Schneider Company, of Montreal ; the Union Petroleum Company of; Canada the Walker Oil Company, of Winnipeg; and the Sterling Oil Works, of Marietta, Ohio.

TELEPHONE RATES.

The rates paid per annum by telephone users in a number of American cities are given below :

	Business.	Residence.
Rochester, N. Y.	$60.00	$48.00
St. Paul, Minn.	84.00	48.00
Kansas City, Mo.	96.00	42.00
Indianapolis, Ind.	72.00	48.00
Providence, R. I.	96.00	78.00
Minneapolis, Minn.	84.00	48.00
Louisville, Ky.	96.00	42.00
Jersey City, N.J.	150.00	75.00
Newark, N. J.	150.75	75.00
Washington, D.C.	125.00	72.00
Milwaukee, Wis.	96.00	60.00
Detroit, Mich.	80.00	46.66
New Orleans, La.	120.00	60.00

PERSONAL.

Mr. H. E. Job, of the T. & H. Electric Company, Hamilton, recently deserted the ranks of bachelorhood, having taken as a life partner Miss Murray, daughter of Mr. Hugh Murray, Grand Secretary of the Masonic Society. The wedding was quiet, Rev. Dr. Wilson officiating.

The Canadian Westinghouse Company, Limited, of Hamilton, Ont., have recently engaged Mr. C. C. Starr, who was formerly connected with the firm of the John Starr, Son & Company, to act as their representative in the Maritime Provinces, with headquarters at 134 Granville Street, Halifax, Nova Scotia. The Maritime Provinces are included in the district of the Canadian Westinghouse Company's Montreal office, and Mr. Starr will be consequently an attache of that office.

The ratepayers of Strathroy, Ont., will vote on a by-law to raise $10,000 to improve and extend the electric light plant.

The Town Council of Renfrew, Ont., has accepted the offer of the Renfrew Power Company to operate fifty lights of 1,200 candle power all night for $1,600 a year.

The Canadian General Electric Company secured the contract for electrical apparatus for the civic plant at Newcastle, N.B., for $4,535. The Goldie & McCulloch Company, Galt, will supply the engine for $2,025.

SPARKS.

The Mount McKay & Kakabeka Falls Company has been granted a charter for a short line of electric railway in the vicinity of Kakabeka Falls, Ont.

The City of Ottawa is asking for tenders up to the 15th inst. for street lighting by electricity; this in addition to the tenders for supply of electric power referred to in last issue.

The term of the School of Practical Science, Toronto, which has just closed, was attended by upwards of 350 students, half of whom took the mechanical and electrical course.

Mr. J. Alex'r. Culverwell, managing-director of the Central Ontario Power Company, owners of the Burleigh Falls power, has recently purchased the Buckhorn Falls power, eight miles back of Burleigh Falls.

Mr. Frank G. Walsh, formerly superintendent of the Bell Telephone Company in Western Canada, who spent the past winter in California, has returned to Winnipeg much improved in health, and it is understood that he purposes again resuming his business duties.

Mr. J. Wilson, Western Superintendent of C.P.R. Telegraphs, states that it is the intention to spend about $20,000 on improvements on the Pacific division. The line along the Columbia and Western Railway, in British Columbia, will be completely reconstructed.

A bill to incorporate the Bathurst Electric & Water Power Company, of Bathurst, N. B., is now before the New Brunswick Government. Authority is asked to construct dams and power plants on the Tetagouche river. The promoters include the Sumner Company, of Bathurst.

The Canadian Rubber Company, of Montreal, recently remodelled their power plant and found that the tall brick chimney, 110 feet high, would not give the proper amount of draft necessary in connection with the four new boilers they were to install. Mechanical draft was necessary and for this purpose a large Sturtevant steel plate fan driven by a Sturtevant horizontal engine was installed and now the proper amount of draft is easily attained and regulated at will regardless of the weather conditions. This installation is another illustration of the necessity of mechanical draft, especially in connection with reemodelling of old boiler plants.

Regarding the proposal of the British Columbia Electric Railway Company to supply the corporation of New Westminster, B. C. with all the power required for lighting purposes, the gist of the agreement entered into is as follows; The contract is drawn for ten years, with the option of renewal by the city for ten years longer. The company is to in a position to supply current within eight months after the signing of the contract one-third in excess of the maximum output of the city's plant on February 1, 1904. The company is also bound to increase the supply at six months' notice. All motors and connections to be provided at the company's expense. The city is to pay for current at the rate of $1.46 per kilowatt hour. The current is to be measured by reliable sealed integrating wattmeters on the switchboards for incandescents, wattmeters connected with the motor circuit for arcs. The company is to pay taxes on all the plant installed. The city electrician is to have charge of all machinery, all repairs, additions and renewals to be made at the company's expense.

MOONLIGHT SCHEDULE FOR MAY.

Date.	Light.	Date.	Extinguish.	No. of Hours.
May 1	7 30	May 1	10 30	3 00
2	7 30	2	11 20	3 50
3	7 30	4	0 15	4 45
4	7 30	5	1 00	5 30
5	7 30	6	1 40	6 10
6	7 30	7	2 20	6 50
7	7 30	8	3 00	7 30
8	7 30	9	3 30	8 00
9	7 30	10	4 00	8 30
10	7 30	11	4 00	8 30
11	7 30	12	4 00	8 30
12	7 40	13	4 00	8 20
13	7 40	14	4 00	8 20
14	7 40	15	4 00	8 20
15	7 40	16	4 00	8 20
16	7 45	17	4 00	8 15
17	7 45	18	3 45	8 00
18	7 45	19	3 45	8 00
19	7 45	20	3 45	8 00
20	7 50	21	3 45	7 55
21	11 00	22	3 45	4 45
22	11 40	23	3 45	4 05
24	0 15	24	3 45	3 30
25	0 45	25	3 45	3 00
26	1 15	26	3 45	2 30
27	5 45	27	3 45	2 00
28	No Light	28	No Light	....
29	"	29	"	....
30	"	30	"	....
31	8 00	31	10 50	2 50
		Total............		167 15

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SPARKS.

The Commissioners of the municipal street railway at Guelph, Ont., are considering the installation of a storage battery plant.

The installation of two electric motors in the waterworks pumping station at Hull, Que., is being considered by the council.

The Clinton Electric Light Company, Clinton, Ont., will likely install additional equipment this year, their present machines being overloaded.

The Sarnia Street Railway Company, Sarnia, Ont., intend building a new car barn this spring, of red brick, 32 x 115 feet, with 20 feet walls.

By a vote of 146 to 42, the ratepayers of Edmonton, N.W.T., on March 31st last, endorsed a proposition to borrow $50,000 with which to extend the municipal lighting plant.

Messrs. McCrackan, Henderson & McDougall, of Ottawa, represent the Du Lievre and Ottawa Railway Company, which purposes building a steam or electric railway from Ottawa to Buckingham, and thence up the Lievre river.

The E. S. Harrison Company, of Winnipeg, have been awarded the contract for the machinery to be installed in the new power house for the city of Regina, N.W.T., to be constructed this spring from plans by John Galt, C. E., of Toronto.

A number of Toronto gentlemen, including Messrs. Joseph Kilgour, Hamilton Cassels, R. S. Cassels, and W. H. Langlois, with Mr. G. T. Marks, of Port Arthur, have formed the Current River Power Company, to develop a water power situate in the township of Shuniah, near Port Arthur.

The concrete dam of the electric plant at Ragged Rapids, Ont., owned by the town of Orillia, gave way recently, and as a consequence the town was without light or power. It is believed that the accident may have been due to quicksand, which caused considerable trouble during the construction of the dam.

The Canadian Light & Power Company is seeking a charter from the Quebec Government. The applicants are Frederick John Shaw, merchant; Frank Howard Wilson, merchant; Albert Francis Duclos, merchant; Frank Warburton Nelles, agent, all of Montreal, and David Kemp Goodfellow, accountant, of Beauharnois. The capital of the company is placed at $1,000,000, and the powers asked include authority to acquire and develop water powers, distribute gas, electricity or other sources of light, heat, or power and to have the right in the city of Montreal and in the counties of Laval, Jacques Cartier, Hochelaga, Laprairie, Chateauguay, Beauharnois, Vaudreuil, Soulanges, Two Mountains, and Argenteuil, of access to, and to establish, construct and maintain under and on the streets and public roads, all pipes, poles, wires, conduits, installations and necessary constructions, under the direction of the municipalities interested, with responsibility for damages therefrom, and on previous notice of one month to that effect to the authorities of the municipalities in question. The exact purpose of the company is not yet exactly known, as those interested state that the time is not yet ripe to divulge the plans of the company.

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SPARKS.

Mr. John F. Lash died at his home in Toronto last month. He was for some years and at the time of his death in the employ of the Bell Telephone Company.

The Weyburn Telephone Company, of Weyburn, N.W.T., intend to construct a line from North Portal to Nilestone, and thence to Regina and Moose Jaw.

The North-American Telegraph Company have petitioned for an act authorizing an increase in the capital stock and changing the head office from Kingston to Winnipeg.

The Calgary Water Power Company, Limited, of Calgary, N.W.T., has been incorporated, also the Alberta Electrical Supply and Construction Company, Limited.

The Bell Telephone Company, in addition to enlarging their central exchange in Winnipeg, intend extending their long-distance lines in southern and western Manitoba, the extensions aggregating 150 miles.

Incorporation has been granted to the Cold Air Electric Power Company, Montreal, capital $20,000, to carry on the business of an electric light, heat and power company. The directors include B. Sawyer, T. H. Schwitzer and H. Timmis, of Westmount, Que.

The proposal for municipal purchase of the Sherbrooke Light, Heat & Power Company's plant, at an agreed price of $233,000, was thrown out by the appeal to the owners of real estate by the failure to obtain the necessary valuation majority. A majority of fifteen votes was obtained, but there was a deficiency of $169-000 of the two-thirds majority in valuation necessary for the passing of the by-law. The City Council are about to apply to the Legislature of Quebec for an amendment to the city charter providing that all by-laws which need the approval of the electors who are owners of real estate shall require the approval of the majority in number but not the majority in value of said electors. It is understood to be the intention of the Council to obtain power to establish their own lighting station at a point some twenty miles outside the city, in connection with a water power purchased some time ago with that object in view.

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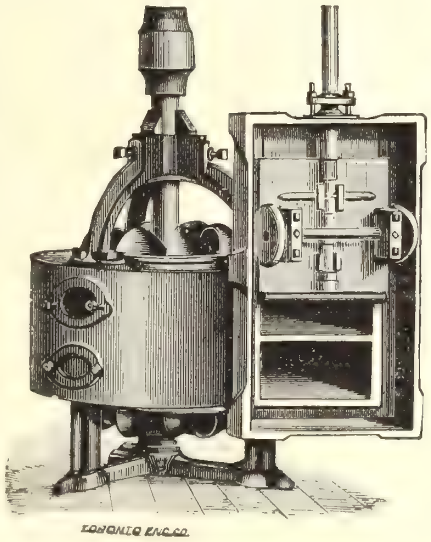
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PUBLICATIONS.

Circulars No. 1077 and 1078, issued by the Westinghouse Electric & Manufacturing Company, refer to "Type L Motors" and "No. 01 Single Phase Railway Motor and Car Equipment" respectively.

The New Motor Bulletin, No. 35, of the Northern Electrical Manufacturing Company, Madison, Wis., is of interest to electrical men. It points out the many advantages of the multipolar motor in general and the many peculiar advantages of the "Northern" motor as manufactured by them.

The first number of the "Clarkson Bulletin,' issued by the Thomas S. Clarkson Memorial School of Technology, has come to hand. The feature of the issue is an address on "The Success of the Educated Man" by Frederick A. C. Parrine, D. Sc., president of the Stanley Electric Manufacturing Company.

The Canadian General Electric Company have issued a neat folder entitled "An Economical Method of Bonding Track". It illustrates and describes the steel and copper caps intended for use with ordinary copper wire for bonding track. They are claimed to be cheaper and can be applied at much less expense, a hammer being the only tool required for installing them after the rails have been drilled.

The first two numbers of The Electrical Magazine, of London, England, have reached our desk. The journal is a splendid example of high-class technical literature, the illustrations being much superior to what is found in many of the British magazines. It contains many condensed articles which are a great time saver to the busy electrical engineer, manufacturer or student. It is edited by Theo. Feilden and issued monthly by the Electrical Publishing Company, Limited, 4 Southampton Row, Holborn, London, W. C., the subscription price being 10s. 6d. within the United Kingdom.

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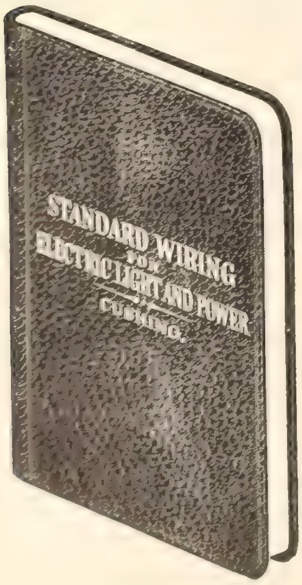

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SPARKS.

The rights of Edward Spencer Jenison to the water power of the Kakabeka Falls and Ecarte Rapids have been restored to him by the private bills committee of the Ontario Legislature. The bill was passed on a vote of 26 to 6.

The Miller Tanning Extract Company, of Millerton, N. B., have installed an electric plant for lighting their factory. It is said that local capitalists are considering the installation of a plant to light the village of Millerton.

The DeWitt Electric Company, Limited, of Truro, N.S., have been awarded the contract for the construction of a telegraph line for the Halifax & Southwestern Railway Company from Halifax to Mahone and from Bridgewater to Liverpool, a distance of 100 miles. The work will likely be commenced about May 1st.

Napoleon Lemay, an employee of the Shawinigan Water & Power Company, was killed in Montreal recently by an electric shock while at work in the power house of the company at the corner of Orleans avenue and Ontario street. He came in contact with a live wire and, according to the evidence submitted at the inquest, must have received about 45,000 volts. The jury brought in a verdict of "no crime" on the part of the company.

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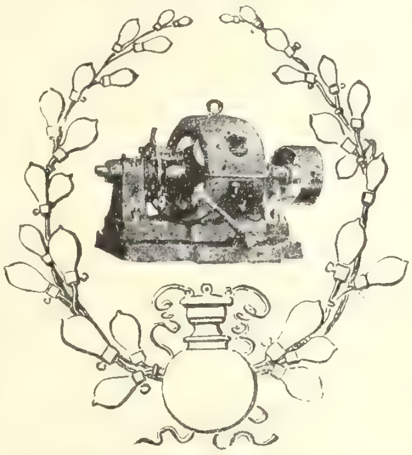

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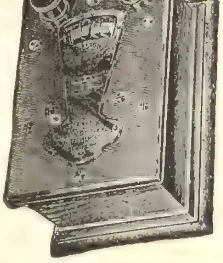

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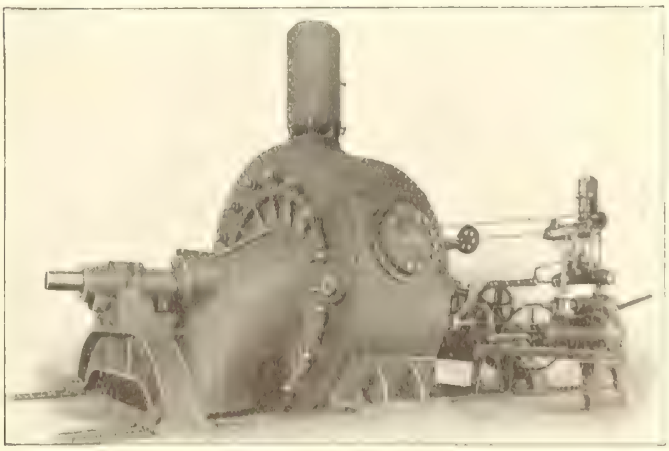

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SPARKS.

The Municipality of North Vancouver, B.C., will probably install an electric light plant.

The Hamilton Cataract Power, Light & Traction Company have just taken tenders on the construction of an enlargement of their hydraulic system.

The parties behind the proposed electric railway from Brantford to Hamilton are Messrs. S. R. Ickes, W. R. Turnbull, C. H. Waterous, H. H. Powell, of Brantford, and J. G. Wallace, of Woodstock. The proposed capital stock is $500,000.

The Bell Telephone Company have made an amended offer for a telephone franchise to the city of Ottawa. The company agrees to supply business 'phones for $45 per year and residental 'phones for $25 if four patrons use the same wire—otherwise it will be $25. They will pay the city $2,500 a year, and also $1,500 they would have paid had their exclusive franchise not expired a year ago. If an Act of Parliament be passed requiring that the wires of the company be placed underground, the company is willing that the proposed agreement shall not exempt the company from the operation of such enactment.

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SEND FOR TABLE OF CONTENTS

SPARKS.

The Kent Electric Company, Limited, capital $20,000, has been incorporated by the New Brunswick Government.

Mr. C. E. Shedrick, Sherbrooke, Que., has recently increased his facilities for the manufacture of electrical instruments.

The Northern Aluminum Company, of Shawinigan Falls, Que., have been awarded the contract for transmission circuits for the lighting of the Welland Canal.

Mr. Joseph Barrett has applied to the York Township Council for permission to construct a transmission line along the highways in that township for the purpose of transmitting electric power from Erindale, on the Credit river, to Toronto.

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SPARKS.

The Quebec Electric Company, a new concern, has opened an office at 137 St. John street, Quebec, under the management of Mr. J. D. Ryan, late of the Crescent Electric Company, Montreal.

The Preston and Berlin Street Railway Company has been given power to extend their electric railway to the town of Waterloo and to construct and operate works for the production and distribution of electric power.

Mr. R. S. Kelsch, consulting engineer of Montreal, has designed and is installing a municipal lighting plant for the corporation of Pictou, N.S. There is said to be an opening for a good wiring contractor to locate there, as a great many of the owners of residences, hotels, stores, etc., have signified their intention to use the light. Up to the present time there has been no one in the town to do this interior work.

Mr. Isham Randolph has declared that there is 240,000 horse power awaitng development in the falls and rapids of the Winnipeg river exclusive of the development now being carried on by the Winnipeg General Power Company at Lac du Bonnet, which is expected to produce 50,000 horse power. The present consumption of power in Winnipeg is estimated at 15,000 horse power.

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Courses leading to degrees of Bachelor of Science in Civil, Electrical and Mechanical Engineering, comprising four years of thorough training and resident collegiate work in theory and practise of engineering. Well equipped shops, laboratories, drafting rooms and power plant. Located near Massena and the engineering developments along the St. Lawrence River. Healthful climate. Tuition moderate.

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Electric Light Plant For Sale

Dynamos and whole plant modern and paying well Capable of large increase of business. Liberal terms to party with say $10,000 cash. Address Box 43, CANADIAN ELECTRICAL NEWS.

Young man (25) at present manager of power, lighting and waterworks plant, wishes to change locality. Would like supervision of small plant or chance to get in on station construction work. Address "Superintendent," care of CANADIAN ELECTRICAL NEWS, Toronto

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ELECTRICAL ... DEVICES OF ALL KINDS.
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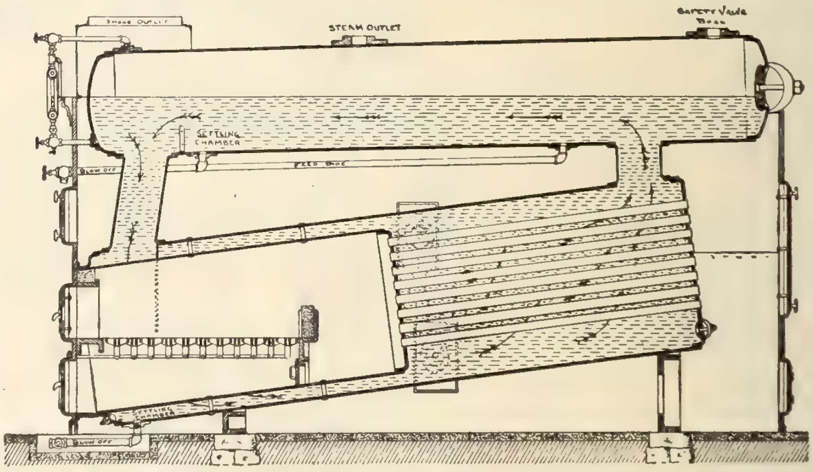

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Oil Separator and Purifier

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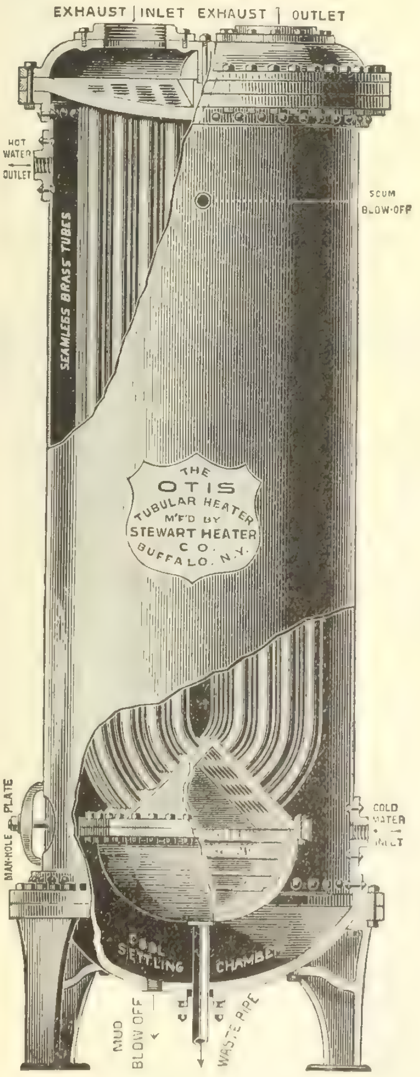

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To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, also to extract the oil from the exhaust, so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

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Catalogue and Prices at Your Service.

THE STEWART HEATER CO.

300 East Delevan Ave.,
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SPARKS.

The Winnipeg Electric Company, of Winnipeg, Man., has been dissolved and the business will be continued by Mr. L. E. Dye.

The Ontario Government has just taken tenders for boiler and steam heating plant and electric wiring of the chemistry, mining, and milling buildings of the School of Practical Science, Toronto.

The new electric power plant of the Canadian Pacific Railway at Fort William, Ont., is about completed, the work having been done under the superintendence of Mr. C. H. Hines, electrical engineer.

ELECTRICAL & TRANSFORMER SHEETS, STRIPS & STAMPINGS
SWEDISH BARS, ROUNDS, SQUARES, FLATS
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MAGNET STEEL FOR PERMANENT MAGNETS.
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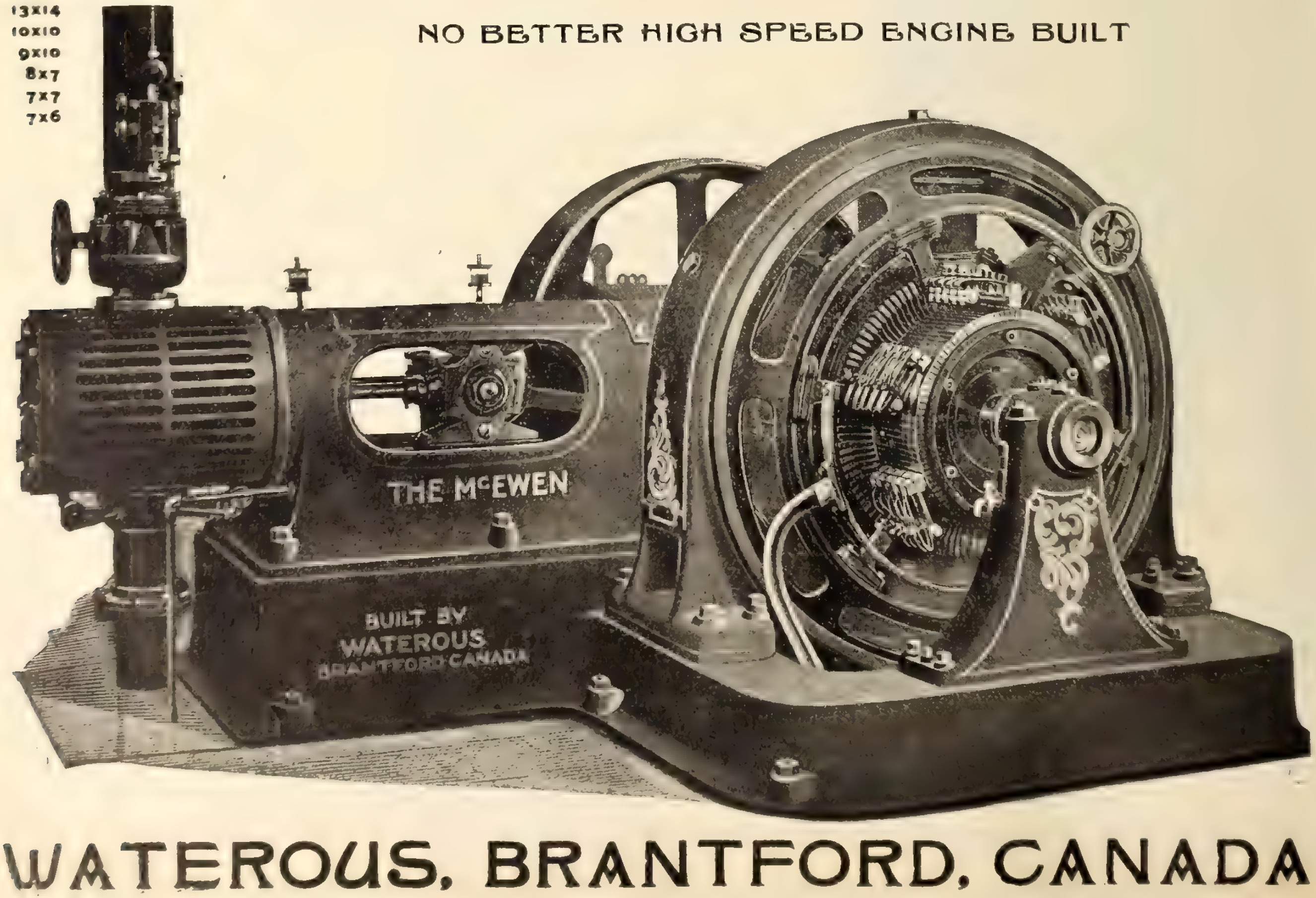

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Single and Double Throw
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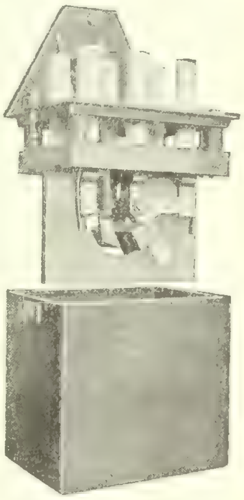
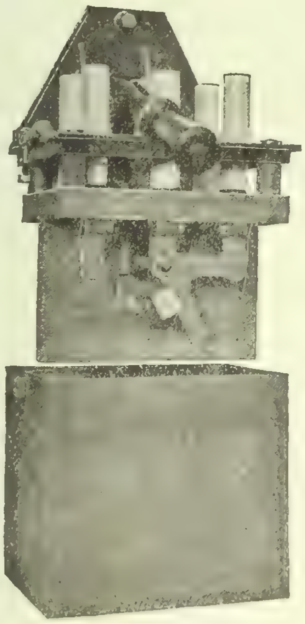
For Switchboard and Wall Mounting

Three Pole Double Throw for Wall or Post Mounting.

Their compact design, the ease of connecting and disconnecting, the thorough insulation of connections, and the facility with which the interior may be inspected, give them a superior adaptability for use under varied conditions,



Three Pole Double Throw for Switchboard Rear View, Tank Lowered.



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No. 5.
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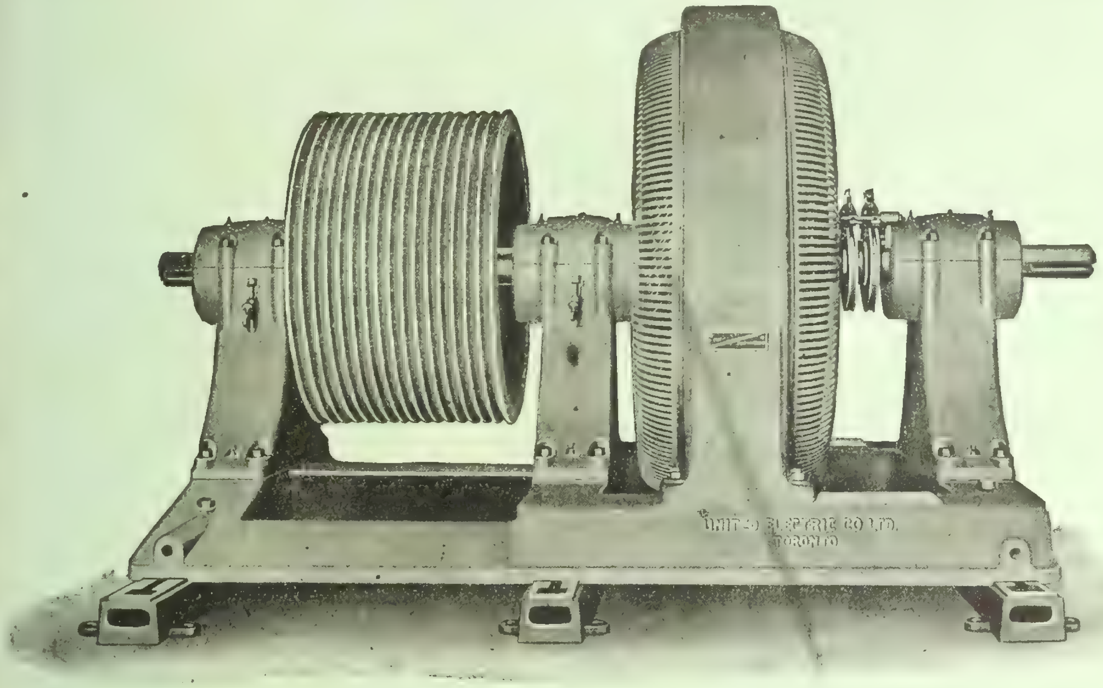

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Our Generators are always strictly up-to-date. Their efficiency over other types will pay your dividends.

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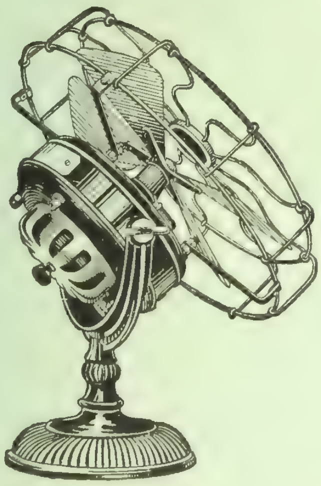
All Standard Types and Sizes



We have added to our line this Season a Convertible Fan Motor. This may be used either as a Swivel and Trunnion Desk Fan or as a Wall Bracket Motor. Our Catalogue describes it.

CEILING FANS 1904

For Direct or Alternating
Current Circuits

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If you have not received a copy of our Fan Motor Catalogue another one will be promptly mailed on application.

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New or Second - Hand, For Sale
Especially equipped for repairs to Electrical Apparatus of all kinds.
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International Time Recording Company,
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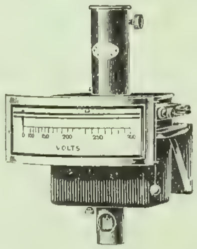

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MANUFACTURERS OF
The Most Symmetrical and Substantial Line of
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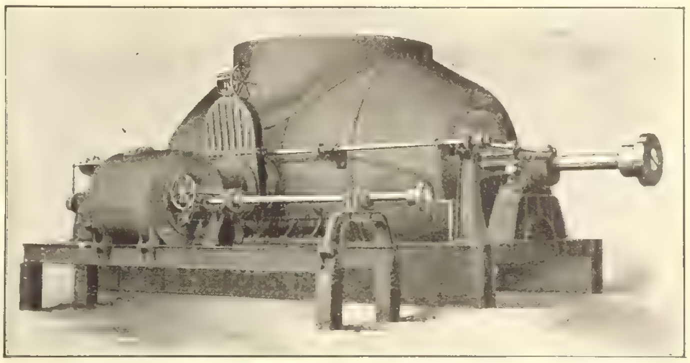
4,000 H. P., 72 ft. head, arranged to drive generator and a single turbine to drive exciter. Five settings built for the Hudson River Water Power Company for their Spier Falls plant and 14 pairs 51 inches for their plant at Mechanicsville, N. Y.



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Write for catalogue if contemplating purchase of Turbines

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R E TYPE. ½ h. p. to 60 h. p. Standard or any Speeds. MOTORS for SPECIAL DUTY built to ANY SPECIFICATION.

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Particulars on application to the

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ELECTRICAL MATTERS AT THE ANCIENT CAPITAL.

The competition for the supply of power in the city of Quebec is showing signs of great activity and attracting no little attention in that city. Two new companies are in contemplation and well under way in their application for a charter, so that in all probability in the near future Quebec will be in the position of being able to boast of four separate electrical power companies. The Electrical Light & Power Company, Quebec and Port Neuf, one of the new concerns will derive its power from a point on the Jacques Cartier River, five miles below the site of the power house of the existing company of that name. The promoters are Messrs. B. Leonard, J. F. Guay, A. Picard, J. Gauthier and M. Clement.

The Quebec Electrical Company will draw their power from Seven Falls,. twenty-five miles below Quebec. The promoters of this company are Messrs. A. R. MacDonald, J. Migner, C. Bergvin and A. Gisard.

It is interesting to note that an order has been established by Quebec authorities in relation to the two electrical companies already in operation in that city to the effect that a space of 3 feet is to be allowed between the poles and wires of one company and that of the other company, thus removing as far as possible the interference of the two currents.

The street railway and electric light commissioners of Port Arthur, Ont., have taken tenders on the installation of a storage battery, but no award has as yet been made.

A NEW ELECTRICAL AND ENGINEERING ORGANIZATION.

The Allis-Chalmers-Bullock, Limited, whose announcement appears in the advertisement pages ot this number, has recently been organized in Montreal.

The company have taken over the business and representation in Canada of the Bullock Electric Manufacturing Co., Canadian Bullock Electric Manufacturing Co., Limited, Allis-Chalmers Co., Ingersoll-Sergeant Drill Co.,Lidgerwood Manufacturing Co., Wagner Electric Manufacturing Co., and Canadian Engineering Co., Limited.

The products of these companies cover a wide range of electrical and engineering apparatus for numerous purposes.

The Allis-Chalmers-Bullock, Limited, will operate in the closest relations to the American companies and manufacture machinery identical in design and of the same high grade of material and workmanship. With shops of the most modern design and equipment and the benefit of the wide engineering experiences of the American companies, the finest class of machinery will be produced.

A portion of the dam belonging to the St. Francis Hydraulic Company at D'Israeli, Que., was carried away by a flood recently. It appears that the frost got beneath one end of the dam which had not been carried down to the bed rock.

Hon. R. Dandurand, Hon. W. A. Weir, Mr. A. Brunet, Mr. J. P. Mullarkey, and others, of Montreal, are applying for the incorporation of the Canadian Traction & Power Company, to build an electric railway from Montreal to Ottawa, and to acquire and develop water powers.

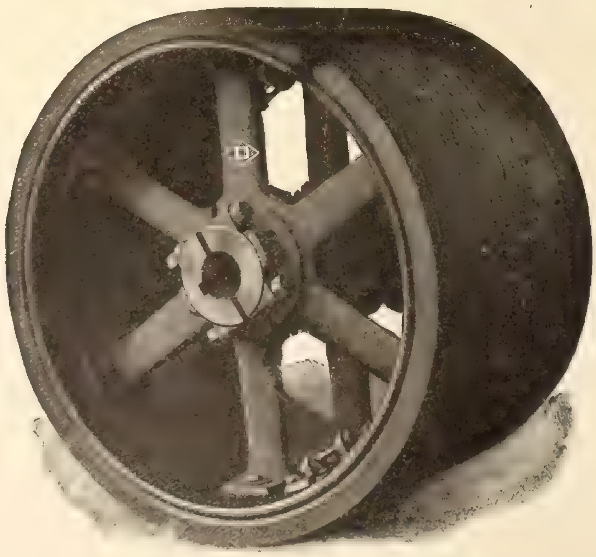
DODGE

SPECIAL

IRON CENTRE WOOD RIM PULLEY

Split or Solid

Safe at
High Rim
Speeds



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Just the Pulley for an Electric Plant

SOLE MAKERS

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This is a 25 kilowatt Pittsburgh transformer, and to our way of thinking it is the finest looking transformer ever made. You do not buy many twenty-five kilowatt transformers but when you do buy them you should get the best. For that matter you cannot afford to spend money on poor ones whether big or little.

This is only another way of saying that you ought to use Pittsburgh transformers—especially the sizes from 1 kilowatt to 300 kilowatts. Get them direct from us.

Pittsburgh Transformer Company,
Pittsburgh, Pa.

SPARKS.

Thamesville, Ont., will submit a by-law to take over the electric light plant.

Improvements are proposed to the electric light plant at Strathroy, Ont., at a cost of $10,000.

The Town Council of Seaforth, Ont., have appointed a committee to ascertain at what price the Seaforth Electric Light Company will dispose of their plant to the town. The present contract expires next September. The cost of lighting the town at present is $1,200 a year.

The Toronto Railway Company have commenced work on their new transformer station near the corner of Yonge street and Davenport road. The station is for the purpose of receiving and transforming the power brought from Niagara Falls by the Toronto & Niagara Power Company. The cost of the building is estimated at $20,000, while the equipment will cost upwards of $50,000.

A special committee of the City Council of Kingston, Ont., appointed to look into the matter of obtaining a supply of electric power, helda meeting recently. Prof. Goodwin reported that there was about 9,000 horse power available between Cross Lake and Dalhousie Lake at low water. He said that $12.50 was the average cost of generating a horse power in Europe, while it cost $15 at Niagara Falls. It is estimated that 3,000 horse power are required in Kingston.

Replying to a question in the Dominion Parliament, Sir Frederick Borden stated that a contract had been entered into with the Lincoln Electric Light & Power Company for the supply of electric power to light the Welland Canal, the price being $14 per horse power per annum. The contract is for the term of ten years. It was pointed out that Mr. M. P. Davis had been given a contract to supply power for the Cornwall canal for 75 years at $63 per horse power.

United States Steel Products Export Co.
Battery Park Building, NEW YORK

Rails and Special Work for Electrical Railways

COPPER RAIL BONDS

With Hollow or Solid Terminals—Applied With Steel Drift Pin or Screw Compressor.

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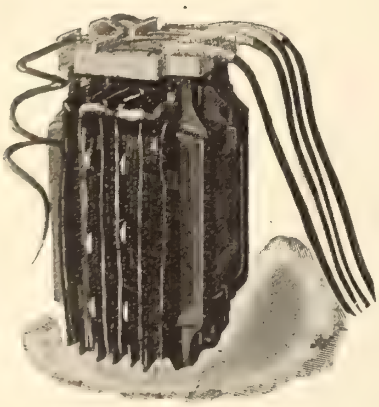

You don't know what transformer perfection is if you do not use our Type "R."

It is the embodiment of pretty nearly everything desirable in Transformer Construction without including the troublesome and undesirable features of previous style construction.

Our Special Bulletin "107" will tell you briefly about Type "R" Transformers. Send for it and let us demonstrate to you how superior a transformer is our Type "R," the transformer which will increase the dividends of any station where installed.

The Packard Electric Company, Limited
St. Catharines, Ont. - Montreal, Que.
Winnipeg, Man.

Weston Patent Sustained and Jewell and Keystone Instruments Enjoined

The fundamental patent for the Weston Direct Current Electrical Measuring Instrument has just been sustained as valid by the United States Circuit Court for the Southern District of New York and as infringed by the direct current instruments, both voltmeters and ammeters and of the portable and station type made by the Jewell Electrical Instrument Co., of Chicago, and by the Keystone Electrical Instrument Co., of Philadelphia.

On March 2nd, 1904, his Honor Judge Hoyt H. Wheeler held patent No. 392387, dated Nov. 6th, 1888, granted to Edward Weston for direct current electrical measuring instruments and owned by the Weston Electrical Instrument Company, good and valid, and infringed by the various types of Jewell direct current instruments.

The court said :—

"That this new arrangement of the coil upon pivots in this form of magnetic field, * * * was a great improvement on all or any prior electrical measuring instruments is very plain and obvious from an observation of the things which had gone before. It involved invention of high order and resulted in great success. Neither the anticipations relied upon, nor the alleged want of patentable novelty, seems to defeat or affect the validity of the patent for this improvement * * Decree for the plaintiff. HOYT H. WHEELER, J."

On April 2nd, 1904, the same court by His Honor Henry E. Lacombe, Circuit Judge, granted a motion for preliminary injunction in Weston Electrical Instrument Co. vs. J. Franklin Stevens and another, doing business as the Keystone Electrical Instrument Co. The instruments involved were all of the various types of Keystone direct current electrical measuring instruments.

The court said :—

"Without now making any decision as to the other claims it is held that 8, 12 and 13 are valid and infringed by defendant's structure, which certainly is as close if not closer, to device of the patent than was the infringing structure in the Jewell case."

The Weston Electrical Instrument Co. has granted no licenses to any other manufacturers to make or sell its movable coil direct current electrical measuring instrument and all such instruments are unauthorized, and are an infringement of the Weston patent No. 392387.

All who deal in such infringing instruments, and all who hereafter put into use any such infringing instruments, and also all who continue hereafter to use infringing instruments previously installed, are guilty of infringement, and will be held to strict accountability by the Weston Electrical Instrument Co.

The Weston Electrical Instrument Co. is prepared promptly to supply the entire demand for direct current electrical measuring instruments of all types and for all uses.

WESTON ELECTRICAL INSTRUMENT CO.

Waverly Park, NEWARK, N. J., U.S.A.

SPARKS.

The Rosseau River Power Company has been organized at Emerson, Man. Messrs. G. Pocock & Sons are interested.

The Consumers' Electric Company are constructing conduits from the Chaudiere to the power station on Maria street, Ottawa. The cost is estimated at $30,000.

Tenders are invited by the city of Moose Jaw, N.W.T., up to May 14th, for supply of boilers, engines, generators, and other electrical apparatus. The chief engineer for the installation is Mr. Willis Chipman, Toronto.

The annual report of the Sao Paulo Tramway, Light & Power Company, of Sao Paulo, Brazil, shows that the gross earnings for the year ending December 31, 1903, were $1,303,175.16, an increase of $179,889.99 over the previous year. After the payment of dividends $211,164.38 was carried forward. The expenditure for the year amounted to $537,295.78, in which were included the construction of an additional track, a duplicate pipe line, the installation of a 1,000 kilowatt generator at Parnahyba, capable of generating 1,900 horse power, and the extension of the overhead and light and power systems.

Wood-Working Machinery.

The line of wood-working machines made by The Goldie & McCulloch Co., Limited, Galt, Ont., is in great demand. They build an extensive range suitable for almost any kind of wood-working establishments. Their machines are built very heavy and made to stand hard and continuous work. Send for a catalog. Address

The Goldie & McCulloch Co., Limited,
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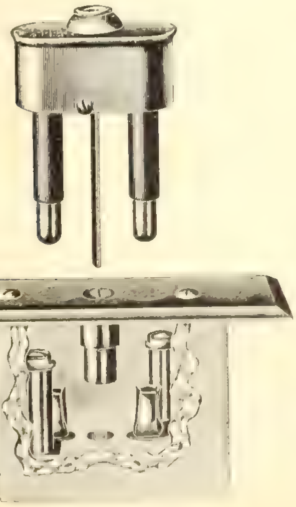

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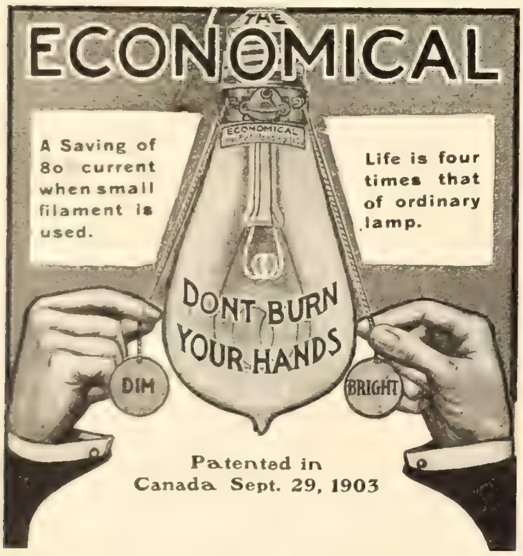
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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

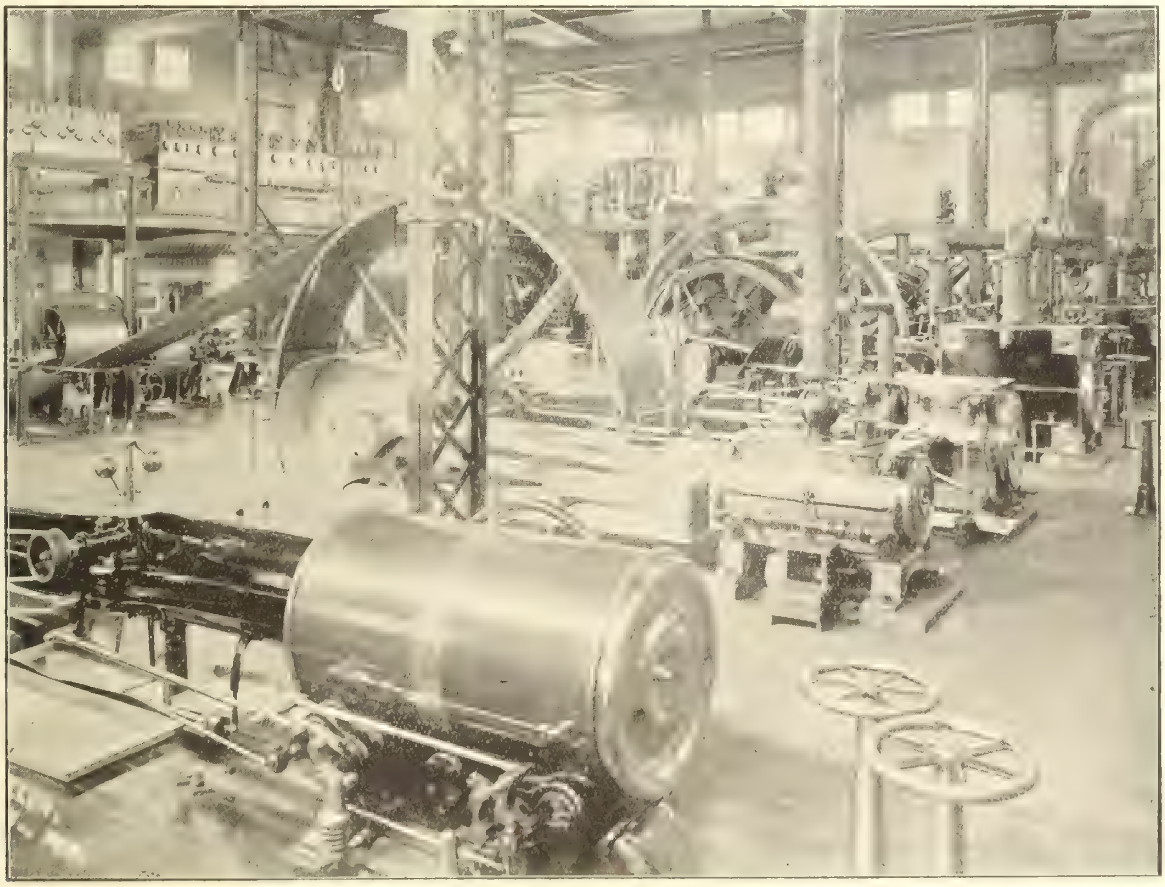
Vol. XIV. MAY, 1904 No 5.

THE WINNIPEG ELECTRIC STREET RAILWAY COMPANY.

Winnipeg is perhaps the only city in Canada in which the street railway, electric lighting and gas services are supplied by the one company. The Winnipeg Electric Street Railway Company, which now controls these services, with the exception of the street lighting, was organized in 1892 and commenced operations in 1893 under a thirty-five years' franchise. At the time of its organization, the Manitoba Electric Light & Gas Company owned the gas works and did commercial and street lighting. Commercial lighting was also being done by the Northwest Electric Company. About five years ago these companies were both absorbed by the Winnipeg Electric Street Railway Company. Four years ago the city purchased its own plant for street lighting only, all commerical lighting being done by the Street Railway Company.

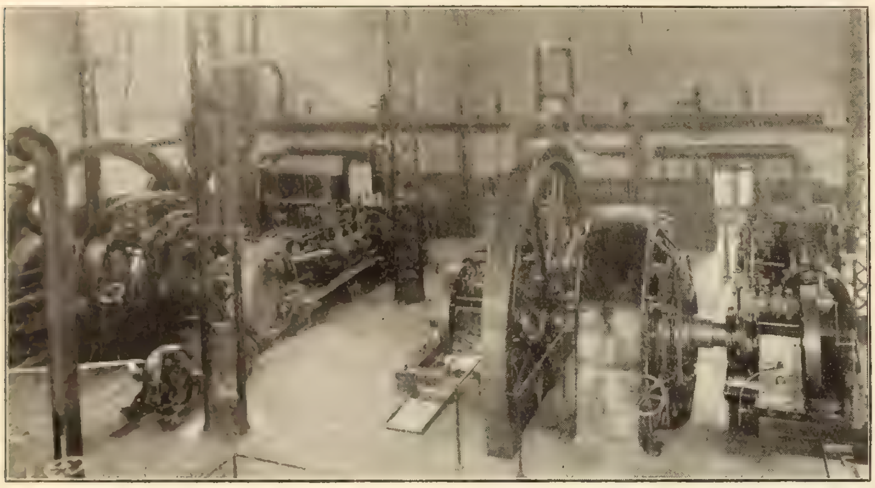
In referring first to the equipment and operations of the street railway, it may be mentioned that four years ago the company had but thirty cars, while to-day it has one hundred. Last year the Portage Avenue line was extended a distance ot six miles along the Assiniboine river past Silver Heights, the former residence of Lord Strathcona. This year it is proposed to extend the line one and one-half miles further to the limit called for by the company's franchise. During the last four years all the company's lines have been double-tracked. They now have twenty-three miles of track, and operate in regular service from thirty to forty cars. During the summer about one hundred cars, exclusive of trailers, are in use.

The company are the owners ot River Park, a beautiful summer resort situated about four miles west from the C.P.R. depot, but within the city limits. This park comprises 180 acres and fronts on the Red River. It contains, among other objects of interest, a Zoo in which may be found all native animals of this western


Winnipeg Electric Street Railway Company—General View in Power House.

country. On holidays as many as 20,000 people have been carried in a single day to this park.

The company's equipment of cars and motors is first-class, and in every respect of the most modern description. A new car barn is now being built at the north end of the city, and car building shops in Fort Rouge. The present large car barn, an interior view of which is shown herewith, has in connection with it well equipped machine and repair shops, a view of which is also given.

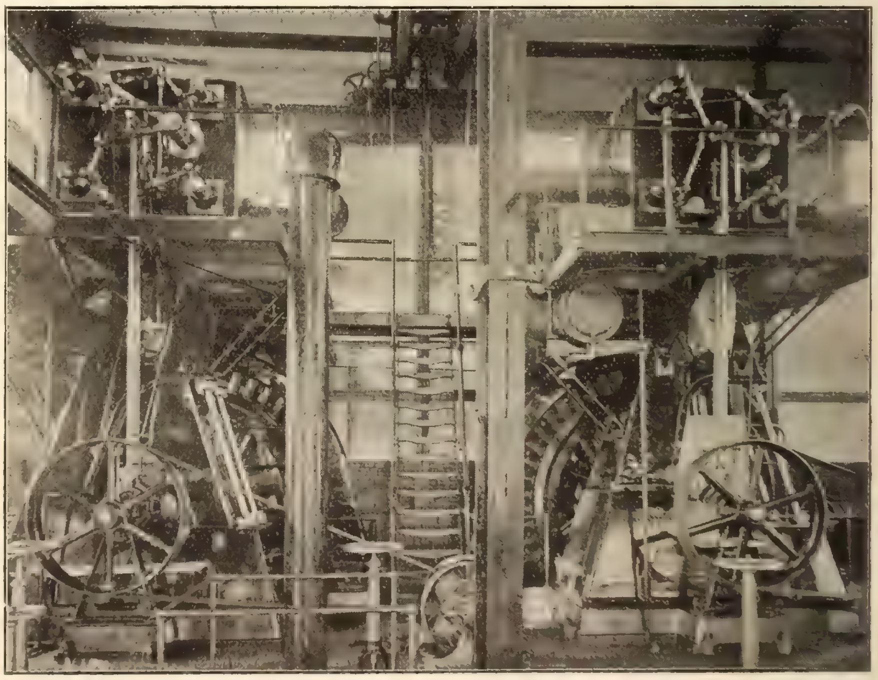


WINNIPEG ELECTRIC STREET RAILWAY COMPANY—VIEW IN POWER HOUSE, SHOWING STREET RAILWAY DIRECT CONNECTED UNITS.

The company's commercial lighting system covers all parts of the city and is well constructed, the poles being straight and tall. In Winnipeg, as in other Canadian cities, incandescent electric lighting is developing with great rapidity. In 1900 there were in use only 16,000 incandescent lights, while to-day there are in use 50,000.

The company have recently been granted a twenty years' franchise for lighting the streets of the neighboring municipality of St. Boniface. For this purpose the series alternating system of lighting will be used, long burning enclosed arc lamps being employed. St. Boniface has a population of 7,000. At the outset the street lighting service will consist of twenty-five lamps. The company have also a street railway franchise for this municipality, under which an excellent service was established last November, the power for which is obtained from the company's central station in Winnipeg.

In addition to the above, the company supply current to the extent of about 450 horse power to electric motors operating planing mills, feed mills, elevators, printing machinery, etc. These motors range in capacity from 1 to 30 horse power.



WINNIPEG ELECTRIC STREET RAILWAY COMPANY—VIEW IN POWER HOUSE, SHOWING VERTICAL ENGINES WITH DIRECT CONNECTED ALTERNATORS.

Several views are shown of the interior of the company's power station, a substantial brick building from which is supplied current for the operation of the street railway and lighting service. In the boiler room of this station are found three 500 h.p. Heine boilers; two 500 h.p. Babcock & Wilcox water tube boilers; twelve tubular boilers of 125 h.p. each, operated at a steam pressure of 125 lbs. In the engine room there are two 600 h. p. cross compound Laurie engines which are direct connected to a 400 K.W.D.C. 500 volt, C.G.E. generator; a 1,200 h.p. cross compound Laurie engine direct connected to an 850 K.W.D.C. 500 volt, C.G.E. generator; a cross compound Wheelock engine, 250 h.p. belted to two Edison bi-polar D. C. generators of 100 K. W. each. For lighting purposes there are employed two vertical cross compound 400 h. p. engines direct connected to C. G. E. monocyclic alternators of 300 h.p. each; one vertical cross compound engine of 600 h.p. direct connected to monocyclic altenators of 500 K.W.; one 1200 h. p. horizontal cross compound Goldie & McCulloch engine direct connected to an 800 K. W. Bullock alternator; two belted C.G.E. alternators of 100 K. W. each. The whole station operates condensing.

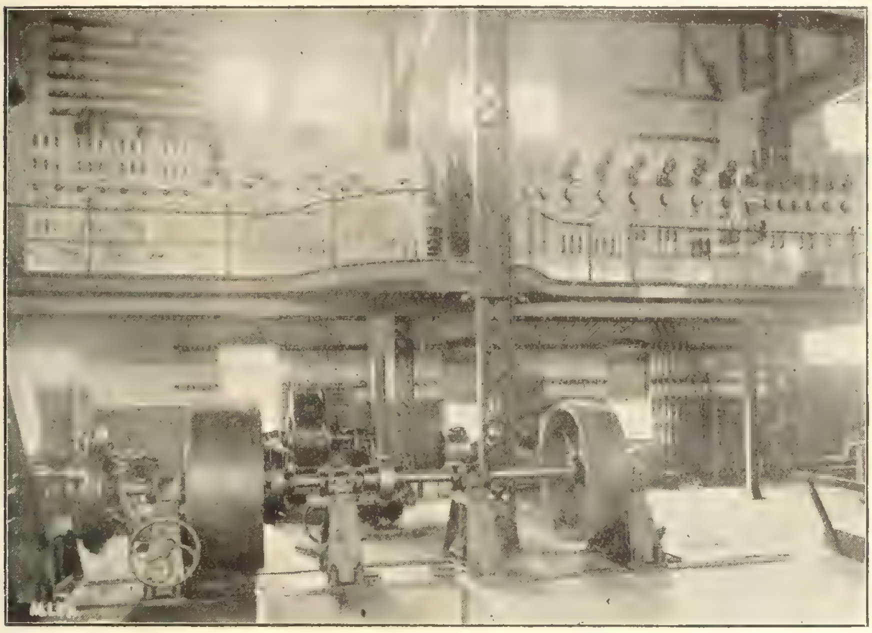
The personnel of the company is as follows: President, William MacKenzie, Toronto; Vice-President, William Whyte, 2nd Vice-President C.P.R.; Secretary-Treasurer, F. Morton Morse; Manager, Wilford Phillips; Directors, William MacKenzie, William Whyte, F. Morton Morse, D. B. Hanna, A. M. Nanton, D. D. Mann and Sir William Van Horne.

Mr. Gays, manager of the Ottawa and New York Railway, states that the final report has not yet been submitted as to the cost of changing the motive power of the road from steam to electricity. Engineers are still at work and will probably complete their figures within a month.

The Robb Engineering Company, of Amherst, N. S., have offered to build for the town of Glace Bay, N. S., one 375 horse power tandem compound Corliss engine, to be shipped about September 1st, freight paid, for $8,850, and allow $1,800 for the old engine. The new engine will enable the town to operate the waterworks pump as well as the lighting.

ELECTRIC SMELTING OF IRON ORES.

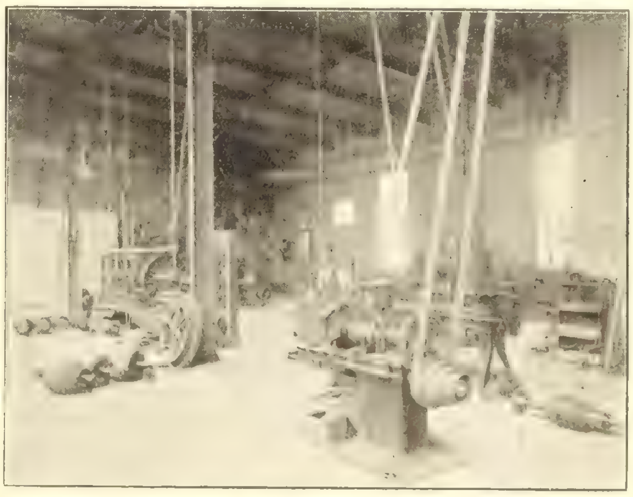
It will be remembered that the Dominion Government, about the close of last year, appointed a Commission to proceed to Europe and enquire into the subject of smelting iron ores into pig iron and steel by the use of electricity. This Commission has returned and the results of the investigations are stated to have been most satisfactory and encouraging. In a preliminary report, furnished to the Minister of the Interior by Dr. Haanel, on behalf of the Commission, the statement is made that it cost approximately $10.60 per ton to produce pig iron by the electric process at Livet, France. The report sets forth the following facts :



Winnipeg Electric Street Railway Company—View Power in House, Showing Switch-Board Gallery.

At Gysang, Sweden, steel of superior quality is made by the smelting together of charcoal, pig and scrap in an electric furnace of the induction type, that is to say, a furnace without electrodes. This process corresponds to the crucible steel process, but it has certain advantages over the latter in that the melted materials at no time during the operation are exposed to gases, some of which when absorbed deleteriously affect the quality of the product. The furnace worked quietly and regularly, producing on the average four tons of steel in 24 hours. "Tapping" occurring every six hours, .116 electric horse power years were required per ton of product. The cost at the rate of $10 per electric horse power a year would be $1.16 per ton of product.

Winnipeg Electric Street Railway Company—View of Boiler Room.



Winnipeg Electric Street Railway Company—View Showing Section of Shops.

THE FRENCH PROCESS.

At Laprah, France, steel is also made from melted scrap. The process differs from that at Gysang in that it permits of the purification of the materials employed, two slags being made for that purpose, and carbonization is effected in the furnace by carbon briquettes. The furnace is of the tilting pattern, consisting of an iron casing lined with dolomite brick. The bottom of the furnace is filled on top of the lining with crushed dolomite, upon which the charge reposes. Two electrodes pass through water-cooled joints in the roof of the furnace. The electrodes are vertical and parallel and are adjusted verticularly either by hand or a specially constructed regulator. An alternating current of 4,000 amperes of 110 volts is distributed to the electrodes. Different classes of steel are made by the company at a cost electric energy absorbed of $1.54 per ton of ingot. The selling price of steel varies from 363 francs 60 centimes to 123 frames 60 centimes per ton, depending upon quality. Interesting experiments were made for the commission at this plant in the production of pig from the ore in a very simple furnace consisting of an iron box of rectangular cross section, open on top and lined with refractory material. The bottom of the furnace in communication with the iron casing constituted one terminal of the electric circuit. A carbon electrode of square cross section and about three feet in length, placed vertically in the open top of the furnace, constituted the other terminal. By hand regulation this electrode could be lowered or raised within the furnace. Thirty charges of ore were made during the working, and thirteen taps of metal and slag taken.

By far the most important experiments witnessed by the Commission were those made by Mr. Keller, of Keller, Leleux & Company, of Livet. Some 90tons of iron ore were use to demonstrate the economic production of pig iron by the electric process. The furnaces employed for these experiments were the furnaces used in the regular work of the company of making by the electric process the various ferros, such as ferro-silicon, ferro-chrome and so forth. The company at the time of the visit of the commission were under contract to furnish ferro-silicon to the Russian Government, but generously interrupted their pressing regular work to undertake the making of experiments for the commission. The furnace employed is of the resistance type, and consists of two iron casings of square cross section, forming two shafts communicating with each other at their lower end by means of a lateral canal. The cases are lined with refractory material. The base of each shaft is formed by a carbon block. These blocks are in electric communication on the exterior of the furnace by means of copper bars. The carbon electrodes to which electric current is distributed pass two-thirds of their length into the shaft. The electrodes are prisms 72 centimetres in diameter and 135 centimetres long. Three sets of experiments were made as follows: (1) Electric reduction of iron ore obtaining different classes of pig, grey, white and mottled. (2) Electric reduction of iron ore containing a definite amount of carbon in the charge, with a view of ascertaining the amount of electric energy absorbed in the production of one ton of pig iron. (3) The manufacture of ordinary steel of good quality from the pig manufactured in the preceding experiments.

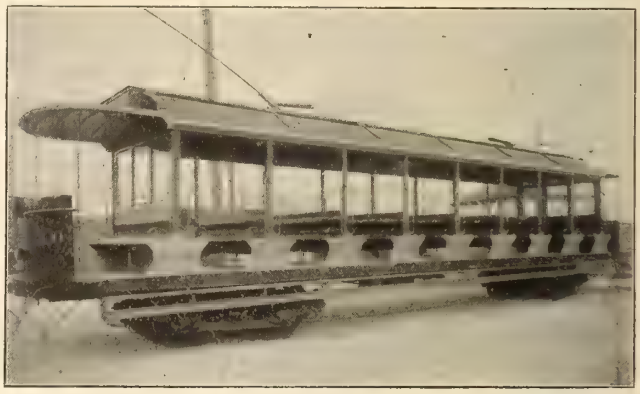
Winnipeg Electric Street Railway Company—Section of Car Barn Looking Towards the Shops and Showing the Inspection Pits.

Winnipeg Electric Street Railway Company—Standard Single Truck Closed Car.

The different classes of pig iron were obtained without difficulty, and the furnaces throughout the experiments worked quietly and without the slightest accident, the gases discharging on top in flickering flames, showing that the gas resulting from the reduction of the ore escaped at low pressure. The workmen employed were ordinary Italian laborers without any special training. A number of castings, such as columns, pulleys, gear wheels, plates and so forth were made with the metal drawn directly from the furnace. The castings showed sharp edges, a comparatively smooth surface, and were sound throughout. For the determination of the electric energy absorbed the voltmeter and ammeter employed to measure the volts and amperes were calibrated in the laboratory of the director of the electrical department of the University of Grenoble, who also ascertained the power factor of the alternator furnishing the electric energy. The electric energy absorbed per ton of pig was found to be .226 horse power years.

COST OF THE PRODUCT.

The following are the figures which go to make up the approximate cost of producing a ton of pig iron: (1) Ore (hematite) metaliic iron 55 per cent., 1.842 tons at $1.50 per ton, $2.76. (2) Coke for reduction, .33 tons at $7 per ton, $2.31. (3) Comsumption of electrodes at $5 per 220 pounds, 77 cents. (4) Lime, 30 cents. (5) Electric energy, 226 horsepower years at $10 per e.h.y., $2.26. (6) Labor at $1.50 per day, 90 cents. (7) Different materials, 20 cents. (8) General expenses, 40 cents. (9) Repairs, maintenance, etc., 20 cents. (10) Amortization (machinery and building), 50 cents. Exclusive of royalty, $10.60.



Winnipeg Electric Street Railway Company — Double Truck Open Car Constructed in the Company's Own Shops.

It must be pointed out, says Dr. Haanel, that the results obtained at Livet were the results of experiments in furnaces not specially adapted to the work required to be done. With the improved furnaces of which the commission has secured detailed drawings, permitting on account of higher column of charge a more effective use of the reducing power of the carbon monoxide evolved and the employment of machinery for charging the furnace to reduce the cost of labor, a much better figure than the one given will result.

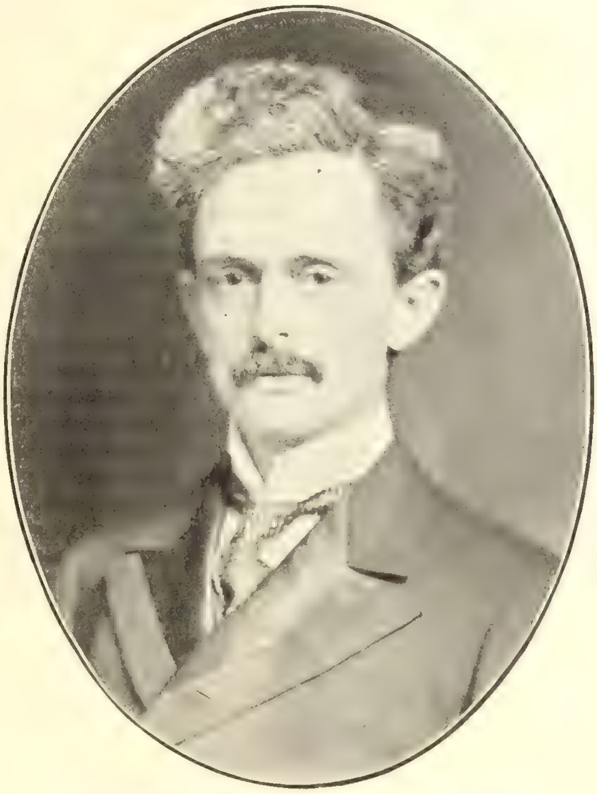
Mr. W. N. Adsit is prepared to receive offers for a franchise for electric lighting in Medicine Hat, N.W.T., with the privilege of the town purchasing the plant after the expiration of ten years. The population is 3,000, and good steaming coal can be obtained for $3.25 per ton.

Messrs. Sadler & Haworth, Montreal and Toronto, were the successful tenderers for the supply of leather belting for the International Portland Cement Company's new plant at Hull, Que. The order amounted to about 7,000 feet of both single and double belting. This is the second order Sadler & Haworth have received from this company, they having fitted up their Durham plant also.

MR. FRED STARK PEARSON.

Of the younger generation of men who have risen to prominence in the engineering field, Fred Stark Pearson, Dr. Sc., consulting engineer, of New York, is an admirable example. While making his headquarters in the Metropolitan City of the United States, he is by no means a stranger to Canadians, as he has been associated with several of the most important engineering works and street railway enterprises in this country.

Mr. Pearson was born at Lowell, Mass., in 1861, and after a public school education secured a position as ticket agent at the College Hill station of the Boston & Maine Railroad Company. This being a flag station, he availed himself of the opportunity of visiting Tufts College, a short distance away, which he was finally induced to enter as a student. Cassier's Magazine tells a characteristic story of his course there. As station agent of the Boston & Maine railroad, there were but few trains for which he had to sell tickets, but there were many trains which he had to flag after they had passed—that is, to show a blue flag as a warning that a train was within five minutes ahead. For this he had to leave his classes at the most inopportune time. He set about to find a way out of this work, and accordingly rigged up an electrical appliance that did the work for him. By his arrangement each passing train was made to complete a circuit by which the blue signal was shown behind it, and the flag was automatically withdrawn in the regulation five minutes. After that young Pearson attended his classes in peace. He graduated in 1879 as chemist and mining engineer, but later re-entered and in 1883 graduated as a civil and electrical engineer, and for the next three years was instructor of mathematics and applied mechanics at Tufts College.



F.S. Pearson, Dr. Sc., Consulting Engineer.

From 1886 to 1888 Mr. Pearson was engaged in mining engineering in various parts of the United States and Brazil, and in the latter year accepted a position as manager of the Somerville Electric Light Company at Somerville, Mass. In 1889 he was appointed chief engineer of the West End Street Railway, of Boston, and undertook the herculean task of equipping the entire system with electricity. This he completed in a mort satisfactory manner, the electric system proving a pronounced success. It is said that in his specifications he demanded electrical apparatus which was at that time not made by the manufacturers, making it necessary to work out many of the details himself. The large belted machines in service at the present time, as well as the direct-connected units, are the results of Mr. Pearson's requirements from the manufacturers. The first 500 k. w. belted generator ever constructed was built from specifications drawn up by him for the West End Street Railway, of Boston. The Boston Heights Railroad Company of Brooklyn, N. Y., shortly afterwards decided to adopt electricity for operating their various lines and Mr. Pearson was chosen as consulting engineer, designing the eastern power station of that company, which was the first direct-connected plant installed in America for street railway service.

In 1893 Mr. Pearson turned his attention to Canada and organized the Dominion Coal Company, as chief engineer of which he had in charge the reconstruction of shipping piers at Sydney and Louisburg, the coal handling apparatus at Montreal, the building of the Sydney and Louisburg railway, and the operating and equipment of the company's mines in Cape Breton in general.

In 1894 Mr. Pearson accepted the position of chief engineer of the Metropolitan Street Railway Company, of New York, constructing the Columbus ave. and Lexington ave. cable roads. The entire system was afterwards changed to electricity under his supervision. He designed the magnificent electric power station of the Metropolitan Company at Ninety-sixth Street and the East River. On account of poor health Mr. Pearson was obliged to resign his position with the Metropolitan Street Railway Company in 1898 and take a long trip abroad.

We will not attempt to summarize all the important commissions which Mr. Pearson has executed in late years, but will mention those in which Canadians are particularly interested. Acting for Canadian capitalists Mr. Pearson a few years ago went to South America to develop a railway, light and power scheme at Sao Paulo, Brazil, now controlled by the Sao Paulo Tramway, Light & Power Company. He also acted in an advisory capacity for the Mexican Light & Power Company, which has an 80,000 h. p. plant in operation in Mexico. He has been retained as consulting engineer by the Toronto Street Railway Company, Montreal Street Railway Company, Winnipeg Street Railway Company, St. John Street Railway Company, Halifax Electric Tramway Company and Montreal and St. Lawrence Light and Power Company. A most important undertaking now under way for which Mr. Pearson is chief consultig engineer is the power plant of the Electrical Development Company of Ontario at Niagara Falls, which is designed to produce 125,000 horse power. He has also made investigations and reports on street railway properties in Liverpool, England; Kingston, Jamaica; Santiago, Cuba; and in a number of other cities of both the American and European continents.

Mr. Pearson is a director of the Dominion Coal Company and the Dominion Iron and Steel Company, and is identified with several companies across the line, including the Electric Storage Battery Company.

THE INSTALLATION OF ELECTRIC CABLES.*

By H. W. Buck, Electrical Engineer of the Niagara Falls Power Company.

I should like to bring up for your consideration to-night a few general points bearing upon that part of an electric power system which has to do with the distribution of the electric current after it leaves the terminals of the generators. The design and invention in electric generating apparatus which has been in progress for the past ten years has resulted in the development of machines which can almost be considered as perfect in their details of construction, and which will give continuous and satisfactory service for many years without repairs. A great deal of thought has also been devoted to the development of those controlling devices commonly known as "switchboards," and appliances and methods of installation have resulted which can be relied upon to meet satisfactorily almost any condition which may arise in the operation of a plant. There is a tendency, however, noticeable in station design, to confine electrical engineering to these two elements of the plant alone; to consider that if the generators are well built and installed and the switchboard constructed along modern lines, that the success of the power system is assured.

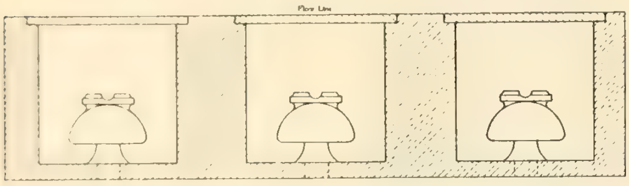


Fig. 1.—Cable Runway for Station Wiring.

Of equal importance, however, in my opinion, is the design and construction of the cable distribution system, considered as beginning at the terminals of the generators. The details of this part of a plant are too apt to be left until after the station has been completed, upon the assumption that the cables can somehow be run along the wall, through some subway designed for another purpose and through holes which happen to exist here and there in partition walls.

Electric cables themselves have undoubtedly reached a high degree of perfection by many manufacturers, but methods of installing them have scarcely kept pace with progress in other departments of electrical work.

I believe that if statistics were compiled it would be found that more shut-downs of electric power plants were caused by cable trouble than from any other cause—not troubles which could be blamed upon the cable manufacturer for defects in construction, but ones which are directly attributable to dangerous methods of installation. If you will stop in the street of a large city some time and look into a manhole of some electric power system which has been opened up for repairs and observe the hopeless snarl of cables crossing and twisting around each other, you will ask yourself what would become of the customers dependent upon those cables if a good short-circuit should occur in that manhole. If you will look into the crowded cable runways in some power stations where cables of all voltages and classes are bunched together unprotected, you will agree that the matter has not received the engineering thought in design that it should.

In selecting this topic, it was not my intention to try to show you how to install cables under all conditions (for I do not think that the matter has as yet been satisfactorily standardized), but I shall attempt, rather, to point out certain general principles and to suggest directions in which improvements can be made.

Cable installation can essentially be divided into two classes—station wiring and underground wiring, overhead aerial cable work belonging more properly to the subject of power transmission.

STATION WIRING.

In laying out the design of a power plant every wire and cable should, if possible, have a definite place provided for it in advance, just as much as for any other piece of machinery. Cables of different classes, that is, cables carrying currents of different voltages and kinds, should, as far as possible, be kept apart from each other. This is a matter of great importance, in order to prevent an interlinking of different systems in case of trouble. I have in mind a case where the secondary leads of a series transformer were bunched together with some small 110-volt direct-current switch-operating leads led from the exciter system. This combination is very common in modern power plants. Through an abnormal rise of voltage on the system the high-voltage primary of this series transformer broke through to the secondary, which in turn struck through to the adjacent 110-volt direct-current lead mentioned, and the whole exciter system became charged with high potential, doing considerable damage.

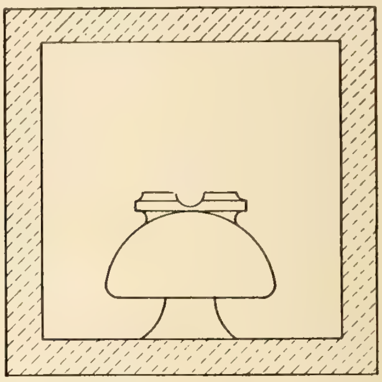


Fig. 2.—Wall Opening for Low Voltage Cables.

In laying out a power station cable system the questions are often raised whether to use lead-covered or braided cables, and whether to run in ducts or expose upon racks in cable subways. In my opinion, lead-covered cables should not be used in a power house except in places where protection against water is required. The lead sheath being necessarily grounded makes the cable vulnerable to puncture from ground throughout its entire length, which danger does not exist in a braided cable. On account of the softness of lead, it serves as a very poor guard against mechanical injury. If a lead-covered cable is struck the grounded lead is very likely to be driven through the insulation to copper, and the cable is put out of business. Braid-covered rubber cables are not exposed to this risk. As a protection against fire, a lead covering is useless, for the lead melts at a very low temperature, and exposes the inflammable insulating compound to ignition. When once started, a lead-covered cable will support its own combustion until completely destroyed.

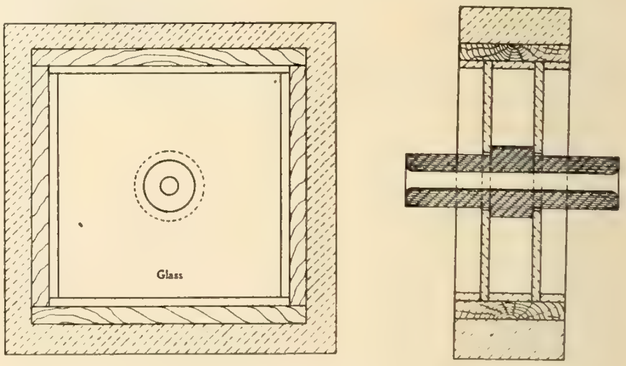


Fig. 3.—Wall Opening for High Voltage Cables.

In high-voltage work a single-conductor lead-covered cable is especially objectionable. Static discharges seem to take place through the insulation to the lead, which rapidly injures the insulation—especially rubber—and a break-down soon follows. I have known a number of instances where such single-conductor cables have withstood a test of three times normal voltage and have broken down at normal voltage a few hours after being put in service. These break-downs occur usually near the ends of the cable. In multiple-conductor cables this action does not seem to occur, the static activity probably being neutralized.

The present tendency in power station construction is to put all cables in groups of ducts as a protection against fire. The arrangement serves this particular purpose, but it it is not, in my opinion, a satisfactory solution of the general problem, and it is open to several objections. In the first place, where cables are drawn into ducts a lead sheath is usually needed to protect the insulation from abrasion. If the cable is single-conductor, operating at high voltage, we have the objection stated above against this combination. If the cable is not lead-covered and operates at high voltage, a static discharge also takes place to the tile duct, which breaks down the insulation in time. Furthermore, if the cables in the ducts are of low voltage carrying large currents, and if a number of them are grouped together, serious difficulties will be encountered from lack of ventilation and consequent overheating of the cables.

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*Lecture delivered before The Electric Club, Pittsburg, February 29, 1904.

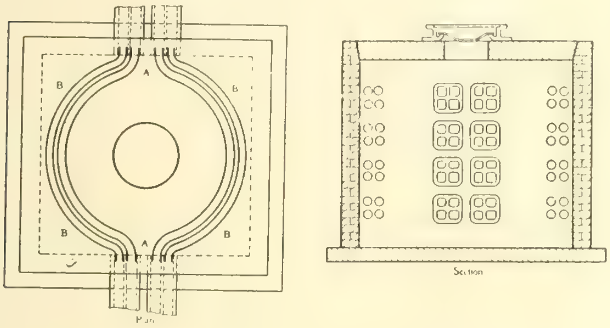

FIG. 4.—ORDINARY TYPE OF MANHOLE.

In my opinion, as a general proposition, especially in high voltage work, the best way to wire a power house is to use braided rubber insulated wire, supported in free air upon porcelain or other insulators which in themselves have sufficient insulation to withstand the operating voltage of the cable. The rubber insulation then serves only as a safeguard to life in case of momentary contact, and to prevent a short-circuit in case of temporarily placing tools or such things upon the cables. Cables should be spread out as far as possible from each other, in order to obtain the best possible ventilation and minimize trouble in case of short-circuit.

In connection with the question of ventilation, I should like to call your attention to the fact that the temperature of the outside of a cable does not indicate its maximum temperature. Some experiments made at Niagara by Mr. H. W. Fisher show that there may be a difference as high as 40° C between the outside of the cable and the inside of the insolation. For this reason cables should have their outside temperature kept lower than is ordinarily the case. In laying out a cable system the matter of ventilation should, therefore, be regarded as of prime importance.

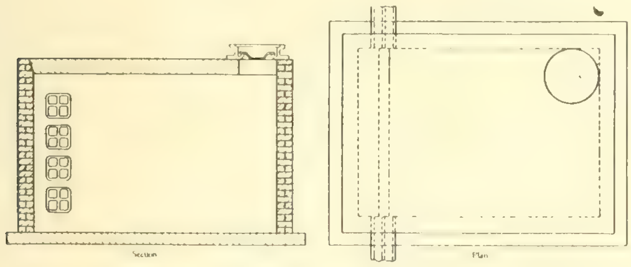

FIG. 5.—IMPROVED FORM OF MANHOLE CONSTRUCTION.

Where cables traverse a floor, the arrangement shown in section in Fig. 1 makes a safe installation for cables of even the highest potentials. Where cables or wires pass through walls, the ordinary method of cementing a porcelain bushing in the wall has objections against it. The bushing is apt to crack from differences of temperature on the two sides of the wall, or from settling-strains in the wall, and a break-down occurs. It is much safer to cut a square opening in the wall and place an insulator as shown in Fig. 2. If exposed to the weather, the construction shown in Fig. 3 is simple and is safe for the highest voltages.

Where a large number of cables have to be led through a subway on account of the conformation of the power house structure, they should preferably be racked on insulators in such a way as to give good ventilation and to render each cable accessible. It is well to locate the cables on the walls of the subway and as low down as possible, so as not to be influenced by the hot air which will float at the top of the subway. When cables are installed in this way they should be rendered fireproof by some means. A method which has been adopted by the Niagara Falls Power Company consists of the following:

Asbestos strip, about 3 inches wide and 3-16 inches thick, is soaked in a silicate of soda solution until it is thoroughly impregnated. It is then, while soft, wrapped spirally around each cable which has been put in place on its rack in the subway. This covering very quickly hardens and forms a coating like stone over the braid of the cable which is fireproof. Asbestos applied in this way has many advantages. It needs no binding wire or steel bands to hold it in place around the cable, which are apt to uncoil when most needed, for the silicate serves as a fim bond. Furthermore, the asbestos, having its pores entirely filled, becomes a good conductor of heat, and the heat from the copper losses can get out by conduction. Dry asbestos, on the other hand, in a porous, cloth-like condition, is a good insulator of heat, which is likely to subject the insulation of the cable wrapped with it to a high temperature. The method of fireproofing here described has been given severe fire tests, and it has served its purpose in every case.

Most of the so-called fireproof braids put on cables are not fireproof for this reason: The coiling and uncoiling of completed cable at the factory and during the process of installation cracks the fireproof braid, which naturally is hard and brittle, and leaves it full of minute cracks and pores. As soon as the cable is heated by the fire the rubber compound of the insulation gives off a combustible gas which comes out through these cracks and burns in the form of numerous little gas jets, which is practically the equivalent of the rubber burning directly. A wrapping of untreated asbestos strip which is sometimes used is no better, for as soon as the fire reaches the cables so wrapped the heat melts the rubber compound and the asbestos wrapping draws it out like a wick and burns furiously.

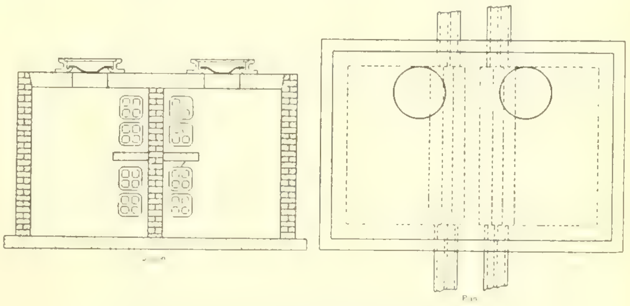

FIG. 6.—MANHOLE CONSTRUCTION ADOPTED BY NIAGARA FALLS POWER COMPANY.

The covering of impregnated asbestos strip, as described, while hard and brittle also, is not moved after it is put upon the cable, and remains solid and homogeneous, without cracks or pores. This, when heated, confines the melted rubber and inflammable gas and does not carry fire.

Special precautions should be taken in installing the cables in a power house which lie inside ot the circuit breakers, for these, in case of trouble, are not protected automatically.

UNDERGROUND WIRING.

The conditions governing underground cable work are quite different from interior wiring. Here lead covering is absolutely necessary for cable protection on account of water, and also because paper cables must be used for reasons of economy, and all cables must be drawn into ducts underground, for any form of subway with bracket supports for the cable would be prohibitive in cost. My objection to the single-conductor lead-covered cables still holds for underground use for voltages over 5,000. Such high-voltage conductors should, if possible, be placed in the form of multiple-conductor cables, where breakdown in insulation from static effects is seldom experienced if liberal sized bells are used at the terminals of the cable.

In connection with underground cable work I should like particularly to call your attention to the grouping of ducts and construction of manholes. Ordinarily ducts are bunched together and brought out at the center of the manhole, as shown in Fig. 4. Here the cables divide, half passing on one side and half on the other side of the manhole, being racked on the manhole walls. This design is objectionable for a number of reasons. First, it exposes every cable in the conduit to damage from short-circuit at the points A-A, where they are in close proximity to each other. Secondly, it necessitates bending every cable sharply at points A and B in every manhole, which tends to crack the insulation and cause trouble. Most break-downs in underground work do occur at these points. Another objection to this form of conduit construction is from the standpoint of heating. The cables in the inner ducts, if heavily loaded, will rise to a high temperature, for there is no way for the heat to get away by conduction. The inner ducts are surrounded by chambers containing still air, which constitute the best possible insulator of heat.

Ducts, in my opinion, should never be grouped more than two in width, so that every duct will have an outlet for heat conduction through the surrounding earth. A much better form of construction is shown in Fig. 5. Here the ducts are grouped only two in width, and the conduit enters the manhole at the side so that the cables can pass straight through on the side wall without bending. A further step in design leads to the arrangement shown in Fig. 6. Here the ducts are still laid in one trench, but the ducts are placed in four separate groups, spaced apart by concrete, as shown. The manholes are built with a vertical division wall through the center and two entrance holes. Removable soapstone shelves divide the groups of cables horizontally, so that not more than one-quarter of the number of cables in the conduit can be damaged by short-circuit at any time. In this design the cables also run straight through the manhole without bending. This construction has been adopted by the Niagara Falls Power Company on all its recent conduit work, and the results obtained have been very satisfactory in practice. In places where rock is near the surface of the ground the construction shown in Fig. 7 is adopted, which requires only a very shallow excavation and affords excellent conditions for the dissipation of heat from the ducts.

The heating of underground conduits is a matter which is overlooked to a great extent, and it is probable that many underground cables for this reason are operating at a much higher temperature than they should. The heating constants vary considerably with the nature of the soil surrounding the conduit, but a fairly safe rule is not to exceed 3 watts per duct-foot as a maximum for copper loss in cable, and not to concentrate too many ducts in one group.

The forced ventilation of underground conduits has been tried but without success. Forcing air under pressure through the ducts has the effect only of lowering the temperature at the end where the air enters, but of raising the temperature toward the end where the air escapes. There is a method, however, of cooling cables in ducts which is very effective, but almost prohibitive in cost, except in a few special cases. It consists of drawing into each duct with the cable a small lead pipe, through which water is kept circulating. This arrangement is used at Niagara in a conduit 250 feet long, between Power House No. 2 and the Transformer House, and the results have been very good.

Where single-conductor lead-covered cables are used in underground installations for carrying large alternating currents at low voltage, trouble from induced current in the lead sheath should be guarded against. I do not refer to local eddies, but to the current which flows in the lead sheath of two parallel cables as secondary induced by the current in the copper of the same cables as primary. This secondary circuit is shown in Fig. 8. When the lead circuit is closed at two manholes by contact with supporting iron brackets the current which flows in the lead is very considerable, and the resulting loss is nearly equal to the I^2R loss in the copper, even at 25 cycles. At higher frequencies this loss will probably be greater. As a specific example I will cite some readings which were taken on two parallel 300-foot lengths of 1,250,000 c. m. cable carrying 800 amperes in the copper at 25 cycles. The open-circuit voltage induced in the lead was 15 volts, and with the lead sheaths short-circuited at one end through an ammeter, the current was found to be approximately 200 amperes. You can see from these figures that the matter is one of greatest importance, and special precautions should be taken in all underground work to meet it. The lead sheaths of all cables should be either bonded together carefully in every manhole or else carefully insulated. If neither one thing nor the other is done, sparking will occur from this lead current at the cable supports at the manholes, which will burn through the lead sheaths and cause a break-down.

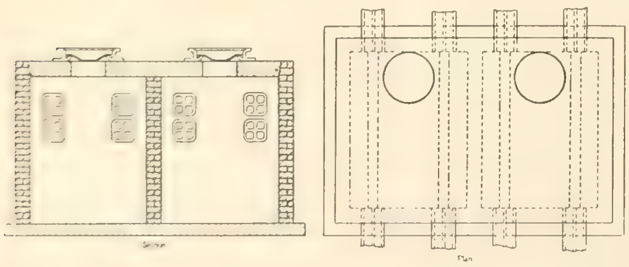

Fig. 7.—Manhole Construction of Shallow Trenches.

In conduits built of insulating material, such as vitrified clay, little trouble need be feared from electrolysis if the conduit is well drained and dry. If the ducts, however, contain water and the cables are partially submerged, the lead covering will rapidly disintegrate, unless the sheath is bonded at frequent intervals to the nearest railway return circuit.

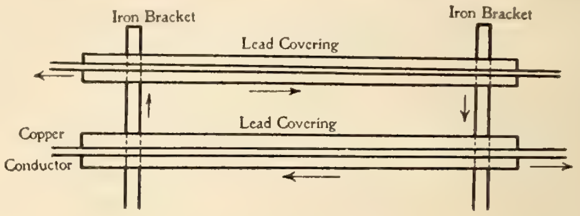

Fig. 8.—Secondary Circuit Formed by Lead Covering.

In conclusion I may say that the points brought out in this paper are not based upon theory, but upon actual experience with a large variety of electric cables operating under various conditions.

PERSONALS.

Mr. Fred P. Cox, representing the Edison & Swan United Electric Light Company, Limited, of London, England, is at present in Canada in the interest of his company.

Mr. George B. Lowe, until recently superintendent of the Cape Breton Electric Company, Sydney, N. S., has secured a responsible position with the Egerton Tramway Company, New Glasgow.

Mr. Hartley Gisborne, electrical engineer, of Ladysmith, British Columbia, has been invited and has accepted membership in the International Electric Congress to be held at St. Louis this year.

Mr. Wilson Phillips, a well known engineer of Toronto, has recently removed to Winnipeg, where he has accepted a position with the Winnipeg Street Railway Company, of which his brother, Mr. Wilford Phillips, is manager.

McGill University, Montreal, has done honor to Mr. Edward Weston, a pioneer in electrical science and research. At the convocation held on April 29th last, the degree of L.L.D. was conferred upon Mr. Weston for his many contributions to electrical science.

Mr. E. B. Merrill, formerly of Toronto, who has for the past four years been connected with the Westinghouse Electric & Manufacturing Company at Pittsburg, has recently returned to Canada and opened an office as consulting electrical and mechanical engineer at 16 King St. West, Toronto.

Mr. John L. Griffin, manager of the Dartmouth Electric Light Company, Dartmouth, N.S., died very suddenly on May 7th last. Mr. Griffin was subject to heart trouble, but apparently had been in good health recently. He was born in Preston in the year 1871, and moved to Dartmouth when but a boy. He learned his trade as a machinist, and upon the formation of the Dartmouth Electric Light Company was appointed manager, which position he held until his death.

Previous to his departure for New York city, Mr. P. G. Gossler, late superintendent and chief engineer of the Montreal Light, Heat & Power Company, was made the recipient of a very handsome loving cup. In the inscription on the cup the dates "1895-1904" were conspicuous, indicating the period during which Mr. Gossler had been connected with the company. The presentation was made by the secretary-treasurer, Mr. H. H. Henshaw, whose words reflected the high appreciation its donors entertained for Mr. Gossler's ability and indomitable energy, as well as the great regret at being deprived of the benefit of his experience and counsel.

Mr. E. S. Hopkins, of the D'Olier Engineering Company, mechanical and electrical engineers, Philadelphia, Pa., recently visited Toronto, Montreal, and other cities with a view to establishing branch offices in Canada for the sale of the DeLaval steam turbine. Mr. Hopkins reports a rapidly increasing demand for steam turbines, as is shown by the fact that there have been turned out over 20,000 horse power in DeLaval turbines ranging in units up to 200 horse power, but chiefly of the smaller sizes. It is the intention to give more attention in the immediate future to the design and development of larger units suitable for central stations and similar work. The New York office of the D'Olier Engineering Company is at 74 Cortlandt street.

SUCCESSFUL STUDENTS AT McGILL.

The following students in electrical engineering are announced to have passed the examinations of McGill University, Montreal :

Frederick Baylis Brown, B.Sc., honors in alternating currents and alternating current machinery, electric lighting and power distribution and electric traction.

Frederick Alexander MacKay, B.Sc., honors in electric lighting and power distribution and in electric traction.

PASSED FOR DEGREE OF BACHELOR OF SCIENCE.

Electrical Engineering.—George Kinghorn McDougall, Montreal, Que.; Geo. Herbert Cole, Ottawa, Ont.; John Haydon Cardew, South Beach, Young's Point, Ont.; George Walker Scott, B.A., Montreal, Que.; Frederick William McCloskey, Boiestown, N.B.; John Allan Wenger, Ayton, Ont.; Alexander Sankey Latty Peaslee, Defiance, Ohio, U.S.A.; Howard Ketchum Dutcher, Charlottetown, P.E.I.; Louis Marotte, Westmount, Que.; John Stone Hunter Wurtele, Actonvale, Que.; Harry Ellis Blatch, St. John's, Nfld.; Herbert Freeman Rodger, St. John's, Nfld.; M. Herbert Roffey, Braintree, Essex, England (aegrotat).

Post Graduate Course.—Frederick Baylis Brown, B.Sc., Montreal, Que.; Frederick Alexander MacKay, B.Sc., Montreal, Que.; George Gordon Gale, B.Sc., Quebec, Que.

THIRD YEAR.

Robert W. Boyle, second mathematical prize for mechanics, Canadian General Electric scholarship.

D. C. Findlay, Canadian General Electric scholarship.

Gordon B. Glassco, prizes for calculus and graphical statics, Canadian General Electric scholarship.

Ian McLeish, prizes for dynamics of machines and electric measurement.

Oswald A. Mundy, Canadian General Electric scholarship.

PASSED THE SESSIONAL EXAMINATIONS.

Electrical Engineering — William C. M. Cropper, Kingston, St. Vincent, B.W.I.; Robert W. Boyle, Carboneer, Nfld.; Ian McLeish, Montreal, Que.; Sidney G. F. MacDermott, Ropley, Jamaica, W.I.; Charlie Willard, Morrisburg, Ont.; Gavin F. Scoulter, New Westminster, B.C.; A. Dale Harris, Ottawa, Ont.; Clifton H. Wright, Barbadoes, W.I.; Lockwood Burpee, Gibson, N.B.; Delmer C. Findlay, Danville, Que.; Gordon B. Glassco, Hamilton, Ont.; Ernest W. Bowness, Kensington, P.E.I.; George A. Johnston, Rednersville, Ont.; Hiram H. Archibald, Harbor Grace, Nfld.; H. Ashley Wheaton, Elgin, Albert County, N. B.; Walter G. Ross, Port Perry, Ont.; Kenneth E. Drinkwater, Montreal ; William Redpath, Montreal; Roy H. Weagant, Derby Line, Vt., U. S. A.; Earnest A. Piche, Montreal, Que.; Stanley Cunha, Kingston, Jamaica, W.I.; John A. Campbell, Cheltenham, Ont.; Oswald A. Mundy, Hamilton, Ont.; H. Lawrence Price, Montmorency, Que.; Moses A. Fulington, Johnson, Vt., U.S.A.; Donald McLean, B.A., Campbellton, N.B.; Raymond P. Bray, Campbellton, N.B.

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Electrical Engineering—William S. Lee, Victoria, P.E.I.; Cecil W. Walker, Kensington, P.E.I.; Royden K. Burland, Yarmouth, N.S.; George E. Brennan, Ottawa, Ont.; John M. Forbes, Bonavista, Nfld.; Melville L. Hibbard, Farnham, Que.; Alexander S. Cram, Smith's Falls, Ont.; B. Howard Higgins, London, Ont.; James G. Beaubien, Outremont, Que.; A. Douglas Gurd, Montreal, Que.; James Harvie, Westmount, Que.; Frederick M. Tupper, Truro, N.S.; Reginald Mudge, Montreal, Que.; Daniel H. Ross, Montreal, Que.; Thos. L. Corrigan, Brockville, Ont.; Alfred M. S. Boyd, Westmount, Que.; W. Sydney Ewens, Owen Sound, Ont.; James DeL. Purdy, B.A., Springfield, N.S.

SUCCESSFUL SCHOOL OF SCIENCE STUDENTS.

The following students in the mechanical and electrical engineering course at the School of Practical Science, Toronto, have successful passed their examinations:

Honors.—First year—W. L. Amos, J. C. Armer, F. Barber, W. C. Blackwood, G. A. Colhoun, R. S. Davis, C. B. Hamilton, A. L. Harkness, C. W. Hookway, A. H. Hull, W. Maclachlan, D. G. Mellwraith, B. W. Marrs, W. K. Sanders, R. L. Sewell, C. L. Vickery, J. N. Wilson, E. M. Wood. Second year—C. B. Aylsworth, G. G. Bell, W. R. Carson, F. W. Harrison, G. Kribs, C. E. Sisson, W. F. Stubbs, E. D. Tilson, W. E. Turner. Third year—J. H. Alexander, J. H. Barrett, A. M. Campbell, C. P. McGibbon, A. E. Pickering, M. R. Riddell, R. S. Smart.

Pass—First year—C. C. Arnott, J. H. Davidge, W. F. Beck, H. H. Betts, W. S. Brady, H. E. Brandon, F. M. Byam, A. Cameron, W. A. Campbell, A. M. Carroll, R. E. C. Chadwick, F. Christie, C. A. Clendening, A. Grawford, N. P. F. Death, E. H. Doidge, C. S. Dundass, S. L. Fear, C. S. Grasett, J. Gray, R. A. Hare, J. C. Hartney, C. R. Hillis, R. H. Hopkins, H. B. Housser, T. Jones, J. C. Kee, J. D. Keppy, C. J. Lamb, A. P. Linton, F. R. Macdonald, J. A. McPherson, H. C. Maguire, W. A. Maxwell, J. E. Meader, C. H. Meader, L. H. Miller, G. N. Molesworth, D. G. Park, C. H. L. Pennington, J. W. Pierce, H. C. Ritchie, L. R. Robertson, A. B. Silcox, J. Young, A. R. Zimmer.

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The St. John Railway Company, St. John N.B., has just installed a new 650 k.w. C.G.E. generator, which will be direct connected to a Laurie engine.

The Winnipeg Street Railway Company are about to commence the construction of several new buildings, including a car shed in the north end of the city, a car shop at Fort Rouge, the extension of the Main street shed, and three large buildings at the Gas Works. It is intended to have all the cars required by the system built in the city in future.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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OUR WINNIPEG OFFICE.

The publishers of this Journal have recently opened a branch office at No. 310 McIntyre Block, Winnipeg. A resident representative has been appointed who will be exclusively employed in advancing the circulation of this Journal and in keeping our readers informed regarding the latest developments throughout the west. The kind co-operation of our friends in the west is solicited in behalf of the success of this enterprise.

Smelting by Electricity.

The smelting of iron ore by electricity is yet in its infancy, but the investigations of the Canadian Commission appointed to report on the subject, which has recently returned from Europe, as briefly outlined in a preliminary report to the Minister of the Interior, leads to the conclusion that this method of reducing iron ore to metallic iron is likely to result in a marked development of the mining industry of this country. The Commission found that at Livet, where the most interesting experiments were seen, the cost of producing a ton of pig iron was $10.60. By means of the blast furnace as now used in Canada, the average cost is perhaps $14 per ton, so that there is a very substantial margin in favor of the electric process. The furnaces used in Europe, however have not been specially designed for reducing iron ore to pig iron by the electric process, and it is probable that with a plant properly constructed, the cost of production could be materially lessened. The large amount of electric current needed for the reduction of ore has been one of the drawbacks to the development and success of the process. In the Livet plant the cost of electric energy to produce a ton of pig iron is placed at $2.26, or over one-fifth of the total cost. With the increased development of the Canadian mining industry which is likely to result through the introduction of electricity, the electrical engineer will be called upon to design electric plants specially suited to the conditions of electric smelting by means of which the amount of energy absorbed will be reduced to the mimimum.

Necessity of Thorough Construction.

One branch of electrical work that seems to have made but very little progress in the last ten years is that of the construction of pole lines and overhead distributing systems generally. This is particularly true of Canada, where the early methods employed by the telegraph and telephone companies for the erection of their lines are still followed by the majority of companies supplying electric light and power. There appears to have been very little thought or study given to the construction of such systems, and the failure to appreciate the importance of this department in connection with the general operation of the system has led to very unsatisfactory conditions generally. It is only recently that interest has been awakened in this subject, mainly through the realization by sad experience that the old fashioned method of building pole lines would not do in the case of long distance transmission, and the necessity for building such systems in accordance with scientific principles has brought the electrical engineering fraternity to look upon outdoor construction work as a field demanding immediate consideration. It is not alone the companies in the smaller towns who are offenders with respect to poor overhead construction, but it would almost seem that the larger the city the poorer is the general class of work done. It must be admitted, of course, that in the case of the latter places the multiplicity of circuits of various kinds makes the problem very complex, but this is all the more reason why a careful study of the situation should be made. In the construction of an electric light and power overhead distributing system primary importance is nearly always attached to the electrical and economical features of the installation, the engineer being desirous of obtaining the best results electrically with a minimum of cost for material. It should be pointed out, however, that other considerations are very important and we believe that they can be kept in sight and still the results mentioned before attained, while the benefit to the community at large would be very great. In this connection we would suggest that it is very necessary in order that entirely satisfactory results be attained that the various municipal authorities should co-operate with the electrical companies in order that distributing systems may be installed which will at once provide a maximum of efficiency in the system combined with a high degree of convenience in operation and immunity from danger to either property or life. By a little of this co-operation much of the unsightly spectacles presented by mutilated shade trees and irregularities in construction work practically necessitated by friction with the authorities would be avoided and systems could be laid out with due regard for all contingencies. Municipalities should bear in mind the fact, however, that first-class construction work with the advantages to be derived from it require a return, and consideration of this point is frequently neglected in the constant clamour for the lowest possible rates.

The question of high class construction work, together with that of the installation of modern apparatus, brings up another feature of the conditions obtaining in the electric light and power business of to-day. It is undoubtedly true that a great many of the companies hesitate either to increase the capacity of their plants to an adequate degree or to replace old apparatus with more modern and efficient machinery, on account of the widespread agitation for the municipalization of electric light and power plants all over the country. In any particular case where purchase by a municipality is contemplated it is but natural that a company should hesitate to invest more capital in a new plant, practically abandoning the old, and in the event of a purchase losing a considerable portion of their investment. The whole situation is one that demands careful consideration and each central station will have to consider its own special problem. We hope that at the forthcoming Convention of the Canadian Electrical Association, to be held at Hamilton next month, the matter will receive due consideration and be thoroughly discussed.

Co-operation among Engineers.

The importance of co-operation among the different engineers engaged in the consideration of any new electric light or power development is emphasized by many recent installations. Too often power houses are designed without due consideration being given to the accommodation of the machinery for which the power house is primarily to be used. Contracts have repeatedly been let for buildings which have proved to be entirely unsuited for the apparatus when it came to be installed. One would expect this to be the case more frequently with regard to the smaller plants, but in many of the large ones this defect is noticeable. We suppose this is true particularly in Canada where the rapid development of power plants has not been accompanied by the development of engineers thoroughly qualified for the various lines necessary for the proper and intelligent design of a complete plant. A few years ago when the size of individual machines was small and belted units were the rule rather than the exception, this matter was not so important, but in these days of heavy direct connected machines it is absolutely essential that the building should conform to the proper lay-out of the machinery it is to contain and due regard should be had to providing proper facilities for handling machinery. Not only are the buildings unsuited for heavy apparatus, but accommodation for switchboard apparatus seems to be entirely omitted. More inconvenience and real danger is caused by improper accommodation for switchboard apparatus and suitable provision for locating and installing the conductors leading from the machines and switchboards and providing for the safe and proper placing of lightning arresters than most people realize. In any prospective installation a consideration of the plant and its proper arrangement should be considered before any attempt is made to design a building, and this building should be laid out to conform to the requirements of the case. Architects and civil engineers should appreciate the importance of this part of the work in which they are engaged and co-operate to as great an extent as possible with those who have the handling of the electrical part of the equipment in charge. If, as frequently happens, an architect or civil engineer is entrusted with the entire control of the work, he should have the assistance of some one well qualified to advise him in this direction.

CANADIAN ELECTRICAL ASSOCIATION.

The dates for the annual convention in Hamilton are the 15th, 16th and 17th of June. A strong local committee with J. A. Kammerer and Gordon Henderson at its head is energetically pushing along arrangements for visits to points of interest, the annual dinner, etc. The last day of the convention will be devoted to visiting the Hamilton Electric Light and Cataract Power Company's works at De Cew Falls and the great elctric power development works in process of construction at Niagara Falls.

Advance copies of the convention papers are being printed and will shortly be mailed out to the members. The printing of the Question Box in pamphlet form is also under way.

A successful convention seems assured. There should be a grand rally of representatives of the electrical interests.

The June number of the Electrical News. will contain the complete programme, and other matter of interest relating to the meeting and the convention city.

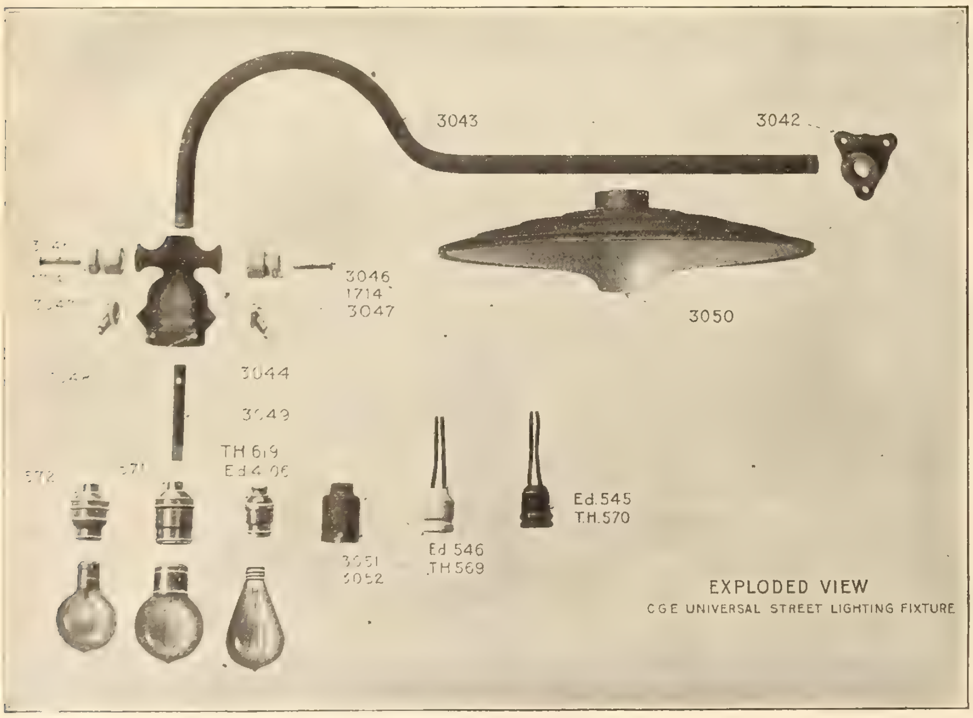
The Secretary of the Canadian Electrical Association, as well as the editor of the Question Box, have experienced considerable difficulty in sending out communications to members of the Association on account of changes of address of which no notification has been given. Members who may have recently changed their address and to whose notice this paragraph may come, are requested to communicate immediately their new address to the Secretary.

NEW STREET LIGHTING FIXTURE.

The requirements of a street fixture to withstand the severe climatic conditions prevailing at certain seasons in Canada are necessarily of a character demanding great care in the design and manufacture. The almost universal use of metal sockets for both series and multiple systems necessitates a device which must completely protect the socket and connecting leads from the effects of rain, snow and ice. The occasional demand for waterproof multiple sockets further necessitates a fixture with which they can be used to advantage. In general, a high-class street fixture must be attractive in design, mechanically strong, and well designed electrically. More particularly is this last feature of importance in fixtures to be used on high voltage series systems, where high potentials are likely to exist between current carrying parts and the structure proper, due to grounded circuits.

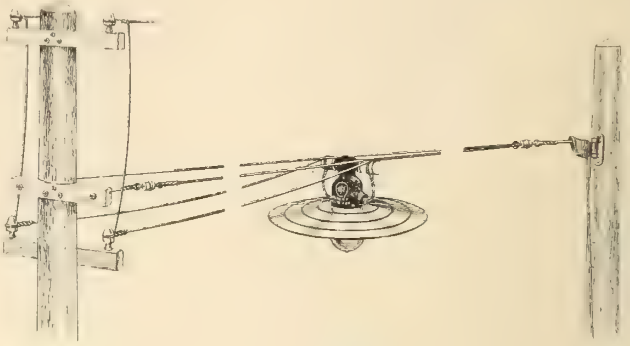
Appreciating the above facts, the Canadian General Electric Company have placed on the market a new street lighting fixture for series and multiple incandescent lamps, which is illustrated herewith. The general form of earlier types has been retained, experience proving that this form is most satisfactory, but in details the new fixture differs radically from any other fixture now on the market. It consists of the following principal parts, viz.: 1, hood; 2, cross arm bell; 3, goose-neck; 4, crow-foot; 5, weatherproof socket holder.

The hood differs materially from existing types of hoods in the formation of a lip or dripping edge at the rim, which effectually sheds all water, thus preventing the dripping of water upon the base of the lamp, usually resulting in softening of the plaster frequently used in cementing the shell to the glass bulb. Another improvement consists in forming the top part of the hood in raised annular sections, greatly stiffening the hood as a whole, and adding to its attractiveness. The hoods are thoroughly coated with enamel, white on the reflective side and green on the top surfaces, the enamel being thoroughly baked to ensure permanency.



EXPLODED VIEW
CGE UNIVERSAL STREET LIGHTING FIXTURE

In the cross-arm bell the manufacturers base their strongest claims for superiority over other types of fixtures. This part consists of a single bell-shaped casting, combining a cross-arm for supporting line wires, and a bell-shaped enclosure for protecting the socket, socket support, and wires connecting thereto from the elements. Experience has proved that the omission of wires from the goose-neck, placing them external to the fixture, and insulating to the point of entrance nearest the socket, is, from an electrical standpoint, the best practice.



C. G. E. Universal Street Fixture.

The cross-arm supports the porcelain knob insulators to which the line wires are attached, and the bell supports and protects the socket supporting tube, through which the connecting wires enter at the highest point inside the bell. The method of introducing the wires to the bell proper ensures almost complete protection from rain, snow and sleet. Porcelain bushings at this point thoroughly insulate the wires from all metal parts. These bushings are leaded to the iron, making an absolutely tight joint, and the cable neatly fitting the bushing, practically makes the entrance waterproof. The cross-arm bell also forms a solid support for the hood, the latter being held in place by four set screws. The hood makes a neat fit with the cross-arm bell, and extends three-fourths of an inch inside, practically preventing water from entering at this point.

Occasionally, conditions exist where the standard goose-neck suspension is unfavorable to the best distribution of light, and it is desirable to suspend the fixture over the roadway from cables as illustrated in the second view. By a simple modification in the design of the arms of the cross-arm bell to provide for suspension from two cables, the new fixture becomes particularly well adapted for cable suspension, and is at the same time interchangeable for either method of suspension.

* * *

It is stated that the Council of Orillia, Ont., have decided to abandon the broken dam of the municipal power plant at Ragged Rapids, and to blast a tunnel through the solid rock for 1,500 feet, the bring the water to a bulkhead at the entrance to the flume and thus prevent the possibility of such accidents as that which occurred this spring. The cost of the work will be about $25,000. An auxiliary steam plant has been installed.

QUESTIONS AND ANSWERS

"Subscriber" asks the following questions:

1. Would a telephone wire (ground return) work satisfactorily on the same poles as a two phase 2,200 volt lighting circuit, distance being five miles?

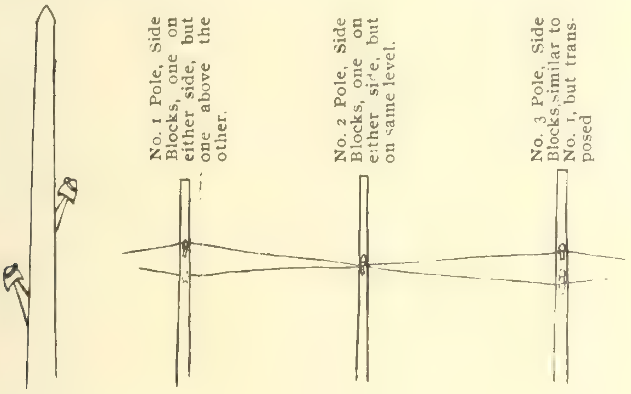
2. At what distance should the telephone wire be from the high potential wires to give best results?

3. How often would a metallic return system have to be transposed to work satisfactorily on the same poles?

Ans.—1. A telephone system with ground return will not work satisfactorily on the same poles as a 2200 volt alternating current lighting circuit, even though the distance should be considerably shorter than five miles.

2. Even with metallic return the telephone wires should be at least five or six feet away from the high potential wire.

3. With a metallic return system to insure satisfactory service the more frequently the wires are transposed the better will be the service. It is just as easy to transpose at every other pole as it is to transpose less frequently. The simplest way of doing this is to run the telephone wires on side blocks. In this way the transposition can be effected without the use of special transposition insulators. (See sketch).


No. 1 Pole, Side Blocks, one on either side, but one above the other.
No. 2 Pole, Side Blocks, one on either side, but on same level.
No. 3 Pole, Side Blocks, similar to No. 1, but transposed

A subscriber in a Northern Ontario town writes: Would you kindly publish for us in your next issue a good draft and specification for a telephone box or closet.

Answes.—Without knowing all the conditions regarding position of telephone cabinet, whether in a building or not, whether one or two sides will be formed by the angle of a room, as is usual, or built clean of the wall altogether, and whether it is to be panelled, or simply built with matched stuff; these points being unknown, a drawing of any kind would likely prove wide of the mark. A specification should be quite ample to enable anyone to construct a telephone cabinet, and we will endeavor to formulate a brief one:—The cabinet should not be less than 2′ 6″ in the clear, inside 3′ would be better. If panelled, the work should be in two thicknesses, with heavy felt paper between. Door should be in two thicknesses, with felt paper between, and woolen felt or heavy cloth should be glued in rebate of door jambs, to keep out sound. If any glass is used the sashes should be prepared to receive two thicknesses of glass with a space between the panes; doors and panelling should be screwed together through the outside face. The ceiling should be covered on the underside with heavy felt-paper or cloth. A tight-fitting plush carpet should be laid on the floor, with heavy paper underneath it. If the cabinet is to be built with ordinary matched stuff, put heavy felt paper on the outside walls and put a second facing of boards over this. Windows and door to be finished like panelled cabinet described.

THE COMPARATIVE EFFICIENCY OF INTERNALLY FIRED AND EXTERNALLY FIRED BOILERS.[*]

By D. W. Robb, Amherst, N.S.

It is generally admitted that theoretically the internally fired boiler should have a lower efficiency than any form which gives better space for combustion, and less close proximity of the fire to the cooling surfaces. It is not often that the two types of setting have been accurately and impartially compared, and hence data and results of trials, made by independent authorities upon boilers of nearly the same capacity, with practically the same coal, and under closely similar conditions, demand unbiassed presentation. It must be clearly understood that the following article is not a comparison between two different makes of boilers, but between two different types of furnaces, types which are open to the entire engineering profession for use, both on land and at sea, the whole forming a valuable contribution to practical steam engineering.—The Editors.

Probably most engineers who are interested in steam-boiler construction and economy, have the opinion that a highly heated brick furnace is more favorable to the complete combustion of the volatile hydrocarbons contained in bituminous coal than the cool surface of an internal furnace surrounded by water; but I think it is at least open to discussion whether the more direct utilization of the heat in an internal furnace, by which radiation and air leakage are avoided, does not more than offset the other advantages of the brick furnace. With either arrangement of furnace it is necessary to admit the proper proportion of air, and the air must be heated to a high temperature, say 1,400 degrees F., in order to produce combustion of the volatile gases. This air is more easily and more naturally heated by passing through the bed of fuel on the grate than in any other way. If cold air is admitted above the fire, combustion will be checked, even with a brick arch; of if a large amount of coal is thrown upon the fire at once, the air supply will be checked and cooled so that the volatile gases, which are being rapidly set free, will, to a large extent, pass off unconsumed for want of sufficient heated air. Therefore, the question of obtaining perfect combustion with either kind of furnace is largely dependent upon the skill and care of the fireman in having the fire of such thickness that the air supply will be properly regulated and in carefully spreading the fuel in small quantities over the fire.

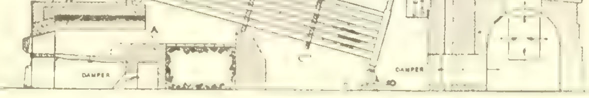


DIAGRAM OF EXTERNALLY FIRED BOILER WITH DUTCH OVEN USED IN PROFESSOR HITCHCOCK'S TESTS.

This result may be obtained mechanically either by the system of underfeed stoking or by down draft on the Hawley plan, by which the volatile gases are forced to pass through the bed of incandescent fuel, thus receiving the heat and air necessary for complete combustion. Either of these systems of stoking may be carried out in a steel furnace surrounded by water as well as in a brick furnace. It is necessary, however, to have the internal furnace large enough to permit complete mingling of the burning gases before they come in actual contact with the cooling surfaces, and in this respect furnaces of small diam eter, such as are used in the Scotch or Lancashire types of boilers, are at fault.

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[*] Reprinted from the Engineering Magazine.

In order to make a comparison of the actual economy of the two methods of burning soft coal for steam generation, a table is given, comprising four trials of steam boilers—two of a water-tube boiler, set in brick, fitted with Dutch oven in front, and two of a boiler of the internal-furnace type. These trials were made at technical schools under the direction of careful and experienced men, and the results were fully and exactly recorded; they correspond closely in conditions, the boilers having about the same amount of heating and grate surface, the coal for three of the trials being from the same mine, and for the other trial of nearly the same calorific value.

The trials of the water-tube boiler with Dutch oven (A and C) are taken from a paper by Professor E. A. Hitchcock, of the Ohio State University, presented at the Saratoga meeting, June, 1903, of the American Society of Mechanical Engineers.

The trials of the internally fired boiler at McGill University (B and D) are taken from a report by Professor John T. Nicholson, D. Sc., formerly of McGill University, now director of mechanical engineering at the Municipal Technical School, Manchester, England, and Professor R. J. Durley, B. Sc., of McGill University.

Description of Boilers.—The equipment at the Ohio State University, especially constructed for the purpose of boiler and fuel testing, (referred to in trials A and C of the table annexed) consists of a water-tube boiler, a Green's fuel economizer, an air heater, induced and forced-draft fans. The boiler (of the Babcock & Wilcox type) has 56 4-inch by 16-foot tubes, and a 42-inch diameter drum, giving a heating surface of 1,070 square feet. The furnace is of the Dutch-oven or fire-brick-arch type with stationary grates, having an area of 25 square feet. The furnace projects in front so that the front of the bridge wall is on a line with the front of the boiler, the arch extending 1 foot 6 inches beyond the end of the grate bars. The boiler is arranged so that it may be operated with or without the fuel economizer or the air heater, and with natural draft, induced draft or forced draft.

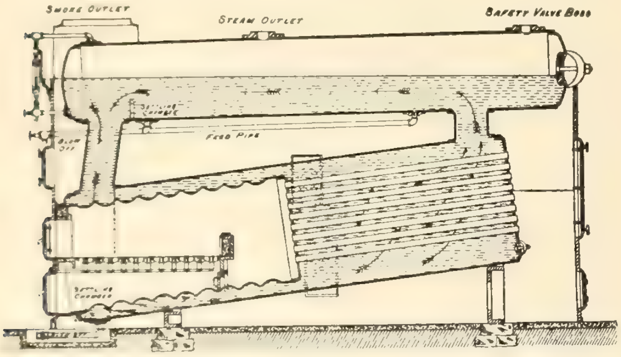

DIAGRAM OF INTERNALLY FIRED BOILER USED IN McGILL UNIVERSITY TESTS.

The McGill University boiler (referred to in trials B and D of the table annexed) is of the Robb-Mumford internally fired type, consisting of upper and lower water and steam drums connected by circulating necks. In the lower drum, the axis of which is inclined upwards about 1½ inches per foot of length, is a cylindrical firebox, from which the tubes lead to the rear head of the boiler. On leaving the tubes, the hot gases are passed over the external surfaces of the boiler between the lower and upper drums and inside a steel casing covered with brick. The inclination of the lower shell and a baffle plate around the upper half of the furnace assist in the natural circulation, which appears to be unusually brisk. The grate is fitted with rocking bars. The principal dimensions of the boiler are as follows: Lower drum 68 inches diameter by 15 feet 6 inches long; upper steam drum 38 inches diameter by 17 feet 9 inches long; furnace 49 inches diameter by 8 feet 3 inches long; tubes 2¾ inches internal diameter by 7 feet 1 inch long, 148 in number; total heating surface (not including the lower surface of the lower shell, which although enclosed is not effective), 1,074 square feet; grate surface 24½ square feet. The boiler is in regular use in the MacDonald Engineering building of McGill University, and is part of the installation which supplies steam for light, power and heating purposes. It can be worked either under natural draft or with forced draft on the closed-ash-pit system.

Apparatus Employed.—For both sets of trials at the Ohio and McGill Universities, draft gauges were used to measure the draft and thermometers and pyrometers to take the temperature of the air on entering the ash pits and the gases leaving the boilers, also for the feed water. Pressure gauges were used to get the steam pressure, and for the Ohio trials a Barrus calorimeter was used to determine the quality of steam. For the McGill trials the steam was taken as dry. For all trials weighing tanks were used for weighing the water, the weighing tanks opening into a collecting tank below from which the water was pumped to the boilers. All steam and hot-water piping was covered with non-conducting material; all fittings were made tight or blanked off to avoid leakage. The fuel was weighed, the time and weight of each barrow load being noted. Samples were taken with each barrow load for the determination of moisture and for calorimetric tests by a Mahler calorimeter, for the Ohio trials, and by a Donkin calorimeter for the McGill trials.

Methods Employed in Carrying on the Trials.—For the Ohio University trials (A and C) with brick furnace and setting, the boiler was fired continuously from thirty-six to forty-eight hours before the trial in order that the brick work should be thoroughly heated. About two hours previous to the commencing of the test proper, the fire was drawn, the damper being closed, grate bars and ash pit cleaned, and a new fire immediately kindled with the coal to be used. This new fire was converted as quickly as possible to the condition to be maintained throughout the trial, the draft being regulated to give the desired fuel consumption and depth of fire fixed to secure the best consumption with the least amount of air excess. The tubes were blown free of soot after starting the fire. About ten minutes before starting the test proper, the exact time being noted, the last fresh coal was thrown on, and five minutes later the fire was levelled with a rake and the thickness determined by resting a bar on the bed of fire and levelling it by sighting on the level gauge and then noting the thickness by graduations on the fire door, which was open just enough to allow the rod to pass into the furnace. At the time for starting, the height of water in the boiler drum was noted on a scale reading in one-tenth inches, fastened to the guage glass, and a string was also put on the glass at the same point as a guide for the person controlling the feed water to the boilers. All readings were taken at regular intervals of one-half hour, commencing fifteen minutes after the test started. The firing was done at regular intervals of three to five minutes, depending upon the rate of combustion, and the amount fired was usually two shovelfuls. At the end of the trial, the same methods were employed as regards firing, the thickness of fire, etc., as at the beginning, and if the water in the boiler was not the same height by the scale, the necessary correction was made for this, based on the calibration of the boiler drum. The fire was then allowed to burn out, when all refuse was cleaned from the grates and the pit. The trials were conducted by A. J. Boehme, G. R. Bott and J. S. Wilson, members of the senior class of mechanical engineering for graduation thesis, carried on under the direction of Professor Hitchcock.

For the McGill University trials (B and D), at the commencement of a trial the fire was allowed to burn down until only just enough was left to light up a fresh fire, the stop valves being manipulated so as to keep the steam pressure constant. At the time of commencing, a known weight of wood (allowed for as half its weight of coal) was fired and firing then began with weighed coal. The fire was opened up as the production of steam increased. The end of the trial was taken to be the time when evaporation ceased, as the last of the weighed coal died down on the grate. Just enough fire was left to light up again. In this way, any uncertainty as to the depth of the fire at the beginning and end of the trial was avoided. The level in the water gauge was the same at the commencement and end in each trial. The trials formed a portion of the regular instruction course in the department of mechanical engineering at McGill College, and were carried out with the boiler at ordinary work, the remaining boilers in the room being steamed so as to take the fluctuations of the load so far as was possible. In no case was special preparation made for the trial, except that the tubes were swept just before the trial began.

TRIALS OF BOILERS.

(A and C with brick furnace—B and D internal furnace.)

Designation of trial	A	B	C	D
No. of trial (original report)	101 B.E.H.	2	160	3
Date of trial	Feb. 2,'01	Nov. 11,'98	Feb. 12,'02	Nov. 18,'98
Type of boiler	Water-tube	Int'l-furn	Water-tube	Int'l-furn.
Duration of trial—hours	10	8h 5m.	9	8h. 22m.
Heating surface—sq. ft	1,070	1,074	1,070	1,074
Grate " "	25	24.5	20	24.5

AVERAGE PRESSURES AND TEMPERATURES.

Steam pressure by gauge, lbs. per sq. in....	134	102.5	98	111.5
Steam temperature, deg. Fahr..............	358	339.2	337	344.6
Draft at damper, ins. water..................	.16	.375	.552	.25
Draft in ash pit, " "	+.08	.0	—.02	+.46
Feed water, deg. Fahr....	166	141	53.2	146
Escaping gases, " "	490	427	556	454
Air entering ash pit, " "	158.5	39	57.9	70
Air used per lb. coal, lbs........	19.41	17.5	18.6	18.9

FUEL AND WATER.

Kind of coal.	George's Creek, R.M.	George's Creek, R.M.	Hackers Run (lump)	George's Creek, R.M.
Coal consumed per hr.—lbs............	375	324.1	581.4	523
Moisture in coal—per cent.............	1.08	1.7	.85	2.2
Ash and refuse in coal, per cent.*......	8.9	6.6	10.48	6.8
Coal per sq. ft. grate per hour..........	14.8	13.23	29.07	21.35
Water evaporated per hour, lbs........	3,262	2,832	4,011	4,234
Factor of evaporation	1.094	1.115	1.203	1.112
Evaporation per hour from and at 212°.	3,569	3,157	4,826	4,708
Evaporation per lb. coal, lbs....	8.69	8.75	6.889	8.09
Equivalent evaporation from and at 212° per lb. of coal—lbs...............	9.518	9.75	8.30	9.00

HEAT VALUE OF COAL AND EFFICIENCY OF BOILER AND FURNACE

A—Heat used in evaporation, B.T.U......	9,192	9,580	8,016	8,480
B—Calorific value of coal, "	14,240	13,900	13,647	13,900
C—Efficiency boiler and furnace, A÷B= C = per cent..............................	64.54	69	58.74	61

ASH AND REFUSE IN COAL.

* The percentage of ash and refuse for trials B and D would have been higher if they had been taken from the analysis as they were for trials A and C instead of by weight (See Prof. Hitchcock's paper, sec. 20), and for this reason the evaporation per pound of combustible is omitted.

Comparison of Trials.—Trials A of the external brick-furnace boiler and B of the internal-furnace boiler were made under natural or low-pressure draft, and trials C and D of the same boilers under forced draft. All of the trials show the evaporation per pound of coal to be in favor of the internal-furnace boiler, and the total efficiency of the two types of boilers and furnaces based on the heat value of the coal, which forms the true test, shows 4.5 per cent. in favor of the internal-furnace boiler for natural draft, and 2.25 per cent. for forced draft. It will be noted, however, that the brick-set boiler and furnace was given the following advantages in the trials:—In trial A for the brick furnace with natural draft the air entering the ash pit was preheated to 158.5 degrees F., as compared with cold air at 39 degrees for the internal-furnace boiler, trial B. Professor Hitchcock's trials (Numbers 116 and 117) show that preheating the air to about the same extent gives a direct advantage of 2.4 per cent. and an indirect advantage, as indicated by less CO in the escaping gases, of 1.3 per cent. So, it would appear that if the air had been preheated for trial B of the internal-furnace boiler it would have shown a total efficiency of 8.2 per cent. better than the brick-set boiler and external furnace.

In the forced-draft trials (C and D) the grate surface was reduced to 20 square feet for the brick furnace and not for the internal furnace. Professor Hitchcock's paper (Sec 26) shows that the reduced grate surface would give an advantage to the brick furnace through less excess of air.

Loss of Heat of Brick Work When Running Intermittently.—In the trials of the brick-set boilers with external furnace at the Ohio University it will be noted that the boiler was fired continuously from 36 to 48 hours before the trials, in order that the brick work should be thoroughly heated, and Prof. Hitchcock states in his paper (Sec. 20) that as a result of a series of trials made especially to determine that point, cold brick walls continued to absorb heat for 72 hours, and increased the loss during the trial 8.5 per cent., and he also states that brick-set boilers should be preheated not less than 30 hours before the commencement of a trial in order to give their best results. This shows clearly the advantage of an internally-fired boiler in cases where steam is used only during the day time or at intermittent periods because the internal furnace will give as good efficiency during the first hour of steaming as at any subsequent period. The exact amount of loss in running a brick-set boiler during the day time only is not shown by these trials, but from Professor Hitchcock's results I think it fair to assume it would not be less than 4 to 6 per cent. in favor of the internal furnace.

It will be noticed in comparing the methods of starting and stopping that Professor Hitchcock used the running start, whereas in the McGill trials the fire was burned down to the lowest possible point before starting and also at the end of the trial. While these methods probably give about the same results, Professor Hitchcock's method would be in favor of the boiler, because the condition of his fire would be at its best from start to finish. It would also seem probable that a fire built up even two hours before the start, as was done in the Ohio University trials, might contain a greater amount of combustible matter at the beginning of the trial than at the end, when there would reasonably be a larger accumulation of clinker and incombustible material on the grate.

The McGill trials do not show any allowance for moisture in the steam; if we assume that the steam from the boiler contained the same amount of moisture as from the brick-set boiler, we should have to deduct 0.8 per cent. for trial A and 1.7 per cent. for trial C from the results of the internal-furnace boiler trials.

To sum up the comparison:—The comparative efficiency of the two types of boilers and furnaces as shown by the trials with the additions for preheated air in trial A, deducting the moisture in the steam, is 7.4 per cent. in favor of the internally-fired boiler when the brick setting and furnace is preheated or run continuously; or if run in day time only, say 11 to 13 per cent. in favor of the internal furnace. Under forced draft and continuous running, the difference shown is slightly in favor of the internal-furnace boiler, although perhaps not outside the limit of error of testing; but under intermittent running the difference would be considerably in its favor.

It may be said that the differences shown by these trials in favor of the internally-fired boiler are within the limits of error of boiler trials conducted by different operators; but taking into account that the firing of the Ohio boiler was done by skilled men, and conducted with a view to getting the best results for the apparatus, while the McGill trials, although carefully conducted, were made with the regular fireman to show the students the methods of testing and the results under ordinary conditions of running; and considering further that the method of starting and stopping the trials at the Ohio University was rather more favorable to the boiler than at McGill—I think the comparison a safe one. But even if the internal-furnace boiler did not give any better results than the brick furnace and setting, it would show that the expense in first cost and repairs of a Dutch oven and brick setting are unnecessary; and especially considering the rapid deterioration and increase of air leakage incident to brick work, when subjected to the intense heat of combustion, they are objectionable as compared with the internally-fired self-contained boiler, which should hold its maximum efficiency in continued service and require much less repairs than the brick furnace and setting.

MOONLIGHT SCHEDULE FOR JUNE.

Date.	Light.	Date.	Extinguish.	No. of Hours.
June 1	8 00	June 1	11 40	3 40
2	8 00	3	0 15	4 15
3	8 00	4	1 00	5 00
4	8 00	5	1 30	5 30
5	8 00	6	2 00	6 00
6	8 00	7	2 30	6 30
7	8 00	8	3 00	7 00
8	8 00	9	3 30	7 30
9	8 00	10	3 30	7 30
10	8 00	11	3 30	7 30
11	8 00	12	3 30	7 30
12	8 00	13	3 30	7 30
13	8 00	14	3 30	7 30
14	8 00	15	3 30	7 30
15	8 00	16	3 30	7 30
16	8 10	17	3 30	7 20
17	8 10	18	3 30	7 20
18	8 10	19	3 30	7 20
19	10 15	20	3 30	5 15
20	11 00	21	3 30	4 30
21	11 30	22	3 30	4 00
22	0 10	23	3 30	3 20
24	0 15	24	3 30	2 45
25	1 30	25	3 30	2 00
26	No Light	26	No Light	
27	"	27	"	
28	"	28	"	
29	8 10	29	10 10	2 00
30	8 10	30	10 50	2 40

Total............146 25

The Montreal Street Railway Company propose to expend a large sum of money this year on track renewals and pavements. These will include the double tracking of Davidson street from Ontario to Nolan street, and new rails on Bluery street, St. Lawrence street and St. Catharines street. The present 72 lb. rails will be replaced by 96-lb. rails laid on steel ties with concrete stringers.

TELEGRAPH and TELEPHONE

A REMINISCENCE OF PRINCE EDWARD ISLAND.

In writing about telegraph cables, and after noting that the first successful cable of the kind in the world was laid across the English channel, a distance of two miles, in 1849, although attempts were made with partial success as early as 1839, the Charlottetown Guardian gives a story which possesses interest in this connection: "On the 21st November, 1852, one of the first telegraph cables ever laid was stretched between Cape Tormentine and Cape Traverse. The event was one of great interest and importance. The work was conducted under the supervision of F.N. Gisborne. The line was not intended to serve merely as a means of telegraph communication between the island and the American continent; it was originally designed, more than fifty years ago, to serve as a connecting link in a projected line to connect New York by telegraph with Newfoundland. Hence the company which laid it was designated by the name of the New York & Newfoundland Telegraph Company. In August, 1868, the telegraph cable at the capes became unworkable, and its repairs were delayed until the following spring, and telegraph communication was interrupted for a whole winter."

INVENTION OF THE TELEPHONE.

Thirty years ago the telephone was invented by Dr. Graham Bell, of Brantford, Ont. In a letter to the Board of Trade of that city Prof. Bell says:

"It so happens that the telephone was invented in Brantford during my visit to my father and my mother in 1874. Up to June, 1876, only laboratory experiments had been made with the instruments, and the transmission of speech was from one room to another in the same building. The first transmission of speech over a real telegraph line was effected in Brantford in the autumn of 1876, on the lines of the Dominion Telegraph Company, by means of instruments which I had brought from Boston. In one experiment speech was transmitted from Brantford to Mt. Pleasant, in another from Brantford to Paris, and in a third from Brantford to my father's house on Tutela Heights, where the results were witnessed by a large company of Brantford people. These experiments were made August 10th, 11th, and 12th, 1876, according to an account published in the Toronto Globe and quoted by the Scientific American of September 9th, 1876. In these experiments the transmission was effected only in one direction, the instruments employed not being well adapted for reciprocal communication. As to citizenship, I was born in Edinburgh, Scotland, and was, therefore, a British subject by birth. I landed in Canada from Great Britain on the 1st of August, 1870, and after a few days spent in Paris, Ont., I removed to Brantford, where I resided with my parents at Tutela Heights until March, 1871. The telephone was invented in Brantford in the summer of 1874. During the whole period of the development of the telephone, therefore, my political status was that of a British subject, who had taken out his first papers of naturalization in the United States, and who, although not a full citizen, was entitled to the rights and privileges of citizenship. The telephone went into commercial use in 1877. We now have more than three million miles in use in the United States."

NEW TELEPHONE LINE.

The Kamouraska & Temiscouata Telephone Company has completed a line running from Riviere du Loup to Quebec, and giving that place, as well as those located between the two points, communication with Quebec, and through a connection with the Bell Telephone Company, with all points in Quebec and Ontario served by that company's wires.

The occasion of the opening of the new line was celebrated by a banquet at the Chateau Granville at Riviere du Loup. Mr. J. Camille Pouliot, the president of the Kamouraska & Temiscouata Telephone Company, presided, and after the toast to the King had been honored, proposed a toast to the town of Fraserville and the counties of Kamouraska, Temiscouata and L'Islet.

Speaking during the course of the evening to a toast to the telephone company, Mr. Pouliot reminded those present that the work whose completion they were gathered together to celebrate was not that of a day or of a single man. It came about through the perseverance, the harmony of ideas and the enterprise of those who were desirous of developing Canadian enterprise. To several of the leading citizens of the county of Kamouraska belonged the credit of having several years ago planted the sapling from which the present tree had grown, vigorous and strong, and whose roots were to-day reaching out into all the corners of the three counties, until to-day it reached points nearly two hundred miles distant. The preliminary labor had now been happily finished and the success of the enterprise was now guaranteed, but they would not rest upon their oars. The company looked to the people to reward the enterprise and the enthusiasm of the promoters by taking a substantial interest in its prosperity, which was due it for the advance it marked in the commercial development of the region.

SHORT-CIRCUITS.

The Bell Telephone Company are seeking a renewal of their franchise in Brantford, Ont.

The Bell Telephone Company are about to install a new multiple switch-board at Toronto Junction, where their subscribers now number 140.

The East Grey Telephone Company, Limited, of Markdale, Ont., has been incorporated, with a capital of $7,000. The directors are Messrs. Christopher Knott, James Fawcett, J. W. Ford, Walter Turner and W. J. Shortell.

The Huntsville Lumber Company, of Huntsville, Ont., have installed a telephone service at Moose Lake connecting the driving camps with the stations along the tributary of the Big East River, down which the logs are driven. Notice can thus be sent back in case of a jam of logs, instead of by a messenger as heretofore, saving much time.

The City Council of Ottawa, Ont., by a vote of thirteen to ten, have decided to give the Bell Telephone Company an exclusive franchise for two years. The main conditions are: Business 'phones, $45; residental 'phones, $25, or $20 when four customers use the one line; the city to be supplied with twenty 'phones free of charge; the company to pay the city $1,500 for business done during the past year, and $2,500 annually during the agreement. An influence in securing the contract was doubtless a statement presented by Mayor Ellis regarding the standing of competing telephone companies.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, May 9, 1904.

The Montreal Light, Heat & Power Company have decided not to make contracts for polyphase motors of capacity of one horse power and under, as they are anxious to develop the use of single phase motors. They are also considering the advisability of quoting special rates for single phase motors with a view of further encouraging their use.

The Town of Westmount (a suburb of Montreal) is talking of installing a municipal plant for arc and incandescent lighting in combination, if possible, with an incinerator. The town has a good record for honest municipal government and might make a success of it, but the chances are that by the time the "talking" is finished the present inhabitants will have sought the realms where we are told "light" is not a saleable asset.

The tremendous decrease in residential wiring in this city this spring can hardly be appreciated by those not actively engaged in that line of work. Some claim that this is due almost entirely to the excessive jump in price quoted by the Montreal Light, Heat & Power Company.

PUBLICATIONS.

The National Electric Company, Milwaukee, Wisconsin, have issued an attractive catalogue of direct connected generators and motors.

A booklet recently to hand describes the Andrae O.K. underground distribution box as manufactured by Julius Andrae & Sons Company, Milwaukee, Wis.

The Westinghouse Machine Company, of East Pittsburg, Pa., have just issued a catalogue descriptive of the Westinghouse-Parsons steam turbine. It is, we believe, the finest and most comprehensive work on this subject ever issued, the illustrations being particularly good. Not the least interesting are the results of tests of steam turbines of various capacities.

The Bath Electric Manufacturing Company, Limited, of Bath, England, have placed on the market the "Kramos" resistance-piece, for which they are finding a large demand. It is not an ordinary carbon resistance, but an electroceramic product quite original in its composition, structure, and methods of production. It is non-corrosive, non-fusible, heat, weather and air proof, and has a great insulation resistance.

"Swingle's 20th Century Hand-Book for Engineers and Electricians" has been published by Frederick J. Drake & Company, Chicago. The author deals in the first part with the operation of steam engines, boilers, feed-pumps, and all the necessary adjuncts of a steam plant, while the second part is devoted to electricity for engineers and contains a great deal of information which all up-to-date engineers should know. The retail price is $1.50.

The McGraw Publishing Company, 114 Liberty Street, New York, have issued a publication entitled "Static Electricity," the author being Hobart Mason, B.S., E.E. It has been endeavored throughout the work to make the reading as simple as is consistent with exactness and a reasonable terseness, and the methods of the calculus have been avoided save where demanded for preciseness or compactness of expression. The retail price of the book is $2.00.

TRADE NOTES.

The Rhodes Electrical Manufacturing Company, Limited, have secured from Messrs. Heeman & Froude, Limited, a contract for the supply of the first lot of motors for coupling up to their ventilating fans in connection with the Underground Electric Railways Company of London, Limited, for the ventilating of the Baker Street & Waterloo Railway.

Supplementary letters patent have been issued increasing the capital stock of the Canadian Bullock Electric Manufacturing Company, Limited, to $1,200,000, and changing the corporate name of the compamy to that of Allis-Chalmers-Bullock, Limited. Permission is also given to manufacture and deal in machinery of all kinds.

The Rhodes Electrical Mnfg. Company, Limited, have informed us that they have established a branch office at 35 McAlpine Street, Glasgow, for the sale of their manufactures (electric motors and dynamos) for the whole of Scotland, under the management of Messrs. James. T. Donald & Company, Limited. All enquiries for that district will be dealt with at this address.

NEW TELEPHONE LINE

A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates :

Port Rowan - 50c.
St. Williams - - 50c.
Vittoria - - 40c.

THE BELL TELEPHONE CO OF CANADA

American Circular Loom Company's FLEXIBLE CONDUIT

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

MONTREAL ELECTRIC COMPANY, AGENTS.

The ORIGINAL and only GENUINE "Circular Loom." Has been in the market for twelve years, and handled by us for over nine years. No other substitute has ever taken its place for quality and adaptability. For price lists, discounts and full information, address

Montreal Electric Company, 354 St. James Street, Montreal

Instant shipment made. Large stock of all sizes always on hand.

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METALLIC SEAMLESS TUBE CO., LIMITED
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—Manufacturers of the—

"Metallic" Steel Conduit System for Interior Wiring

ALSO

Cold Drawn Seamless Steel Tubes, for Boilers, Cycles, etc., etc.

Diploma and Medal Awarded "World's Fair" Chicago, 1893

ELECTRICAL STANDARDIZATION BUREAU.

A deputation representing several of the leading Canadian electrical companies, composed of Messrs. W. Y. Soper and A. A. Dion of Ottawa, J. J. Wright of Toronto, E. A. Evans of Quebec, and G. J. Henderson of Hamilton, accompanied by Mr. O. Higman, of the Electrical Inspection Branch of the Inland Revenue Department, recently waited on the Hon. Mr. Brodeur, Minister of Inland Revenue, and requested that the Government should establish an electrical standardizing bureau to be maintained independent of any other branch of the public service and placed in charge of a qualified electrical expert, at whose disposal should be placed trained assistants and proper facilities. The purposes for which a bureau is required are for obtaining absolute standards for the measurement of electrical qualities and to enable the electrical expert to make tests of instruments and materials. The delegation also asked that the law be amended so that if any device was found in the possession of anyone to prevent the proper registration of electric current it should be regarded prima facie evidence for his conviction.

The Canada Foundry Company have just completed their new boiler shop at the Davenport works, which is one of the most up-to-date establishments of the kind on the Continent. The equipment includes a number of special machines which, it is claimed, are not to be found in any other Canadian shop.

The Ontario Government has granted permission to the Electric Development & Securities Company, incorporated in the State of New York, to carry on a general contracting and constructing business in Ontario, and to generate and supply power, light and heat. The capital to be used is limited to $100,000. Mr. Frederick K. Foster, of Toronto, has been appointed attorney for the company.

SPARKS.

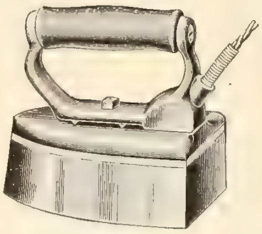
The City Council of St. Thomas, Ont., are considering the extension of the electric railway to Port Stanley.

The Goldie & McCulloch Company, of Galt, Ont., will furnish new engines, boilers, pumps, heaters, etc., for the Sarnia Gas & Electric Light Company, Sarnia, Ont., who are duplicating their present plant.

The Canadian Westinghouse Company, of Hamilton, have secured the contract for supplying transformers and fifty alternating current arc lamps for the electric plant owned by the corporation of Owen Sound, Ont. Messrs. Reid & Kilmer, of Hamilton, representing the General Electric Company of Sweden, will furnish two generators and appurtenances for $6,000.

The Council of Outremont, Que., at a recent meeting passed a resolution empowering the lighting committee to conclude an arrangement with the Montreal Light, Heat & Power Company for street lighting. The company agree to furnish arc lights at the rate of $75 per year, and 32 c.p. incandescent lamps at $22 per year. Gas for lighting the streets, public places, etc., will be supplied at the rate of $17 per year for each lamp consuming five cubic feet of gas per hour. The Continental Light, Heat & Power Company submitted a proposition to light the town by means of gasoline.

Electric Heating Irons



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Highest Efficiency—Neatest Design

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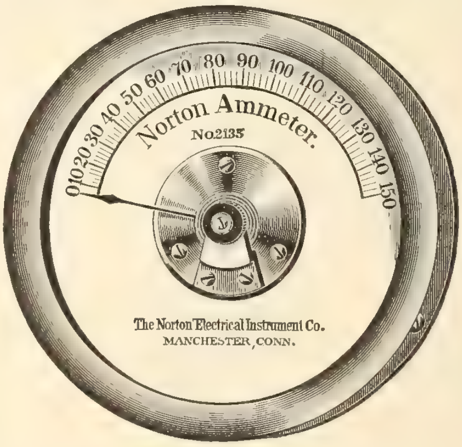
AMERICAN ELECTRICAL HEATING CO., DETROIT, Mich., U. S. A.

Largest and Oldest Makers in the World.


0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Norton Ammeter.
No2135
The Norton Electrical Instrument Co.
MANCHESTER, CONN.

STYLE "A"

Norton D. C.
Volt and Ammeters

"Style A"—Brass.
"Style B"—Oxy Black.
Accurate and Neat.
Prices Competitive.
WRITE.

C. W. BONGARD & CO.

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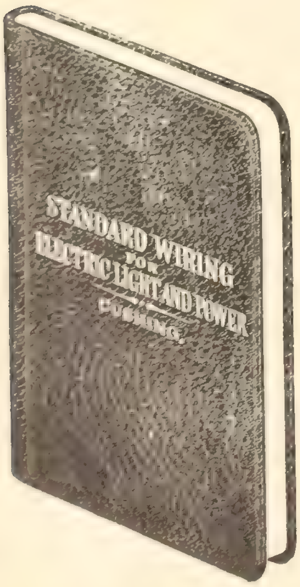
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ENGINEERING NOTES.

The British Columbia Association of Stationary Engineers has recently been formed. A meeting was held in Vancouver on April 28th, at which there were delegates in attendance from Victoria, New Westminster, and outside points. President W. Paddon was in the chair and the principal business transacted was the adoption of a constitution and by-laws.

The Hamilton Branch of the Canadian Association of Stationary Engineers, at their last meeting, arranged to hold a smoker and concert on May 12. The membership of Hamilton No. 2 has increased lately and it is expected to have things in good shape for the annual convention to be held in that city in August next.

Mr. R. G. Black, chief electrical engineer of the Toronto Electric Light Company, gave a very interesting talk before the Toronto Association of Stationary Engineers on April 20th, his subject being "Alternating Current and How to Handle it." Many practical points were taken up and explained in a simple yet thorough manner, and the address was much appreciated by the members.

The water used by a water wheel of 340 horse-power, operating under 1,470 feet head in a plant on the Isere River in France, is measured as follows: The discharge is passed into a large funnel-shape vessel the upper part of which is cylindrical and pierced with 80 rectangular openings disposed around the periphery. The water flows out of the openings, 80 in all, and one of these streams is passed through a water meter as a measure of the total volume.

Steam coal stored under water for two or three years is reported, as the result of experiments made in England, to have lost only 2 per cent. of its calorific value. On the other hand, "The Surveyor" states that some of the railways have observed a deterioration of about 10 per cent. and the British Navy estimated a loss of 50 per cent. by prolonged air storage.

IT IS ALL RIGHT.

L. F. Grawford, Rossland, B.C., in remitting subscription, remarks: "THE ELECTRICAL NEWS is all right."

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FOR SALE

1–50 K.W. S.K.C. Generator, 2000–1000 volts, 8000 alternations, with 2½ K.W. Exciter and Station Apparatus complete.
1–5 H.P. S.K.C. Motor, 8000 Alts., 500 volts, with necessary Transformer 1000–2000–500.
1–25 K.W. R. E. Co. Bi-Polar D. C. Dynamo, wound for 110 volts, with sliding base, pulley, brushes, etc., complete.
2–12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.
The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address

THE VOLTA ELECTRIC STORAGE CO.,
39 James street South,
Hamilton, Ont.

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A Weekly Journal of advance information and public works.

The recognized medium for advertisements for 'Tenders.

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MANUFACTURER OF . . . . . . **Electrical Specialties**

RELIABLE DURABLE EFFICIENT ECONOMICAL

"Shawmut" Tested Fuse Wire and Links
"Shawmut" Enclosed Indicating Fuses
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"Boston" Cable Hangers
"Cushing" Theatre Switchboards
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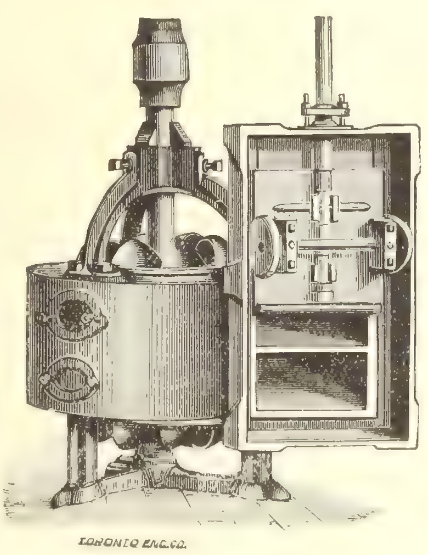
Switchboards and Panel Boards
Electrical Repairing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Made in 44 sizes, from 4 inches to 60 inches diameter, in either iron scroll case (see cut) or in flume case.

Complete stock of turbines on hand to insure prompt shipment.

Machine dressed gearing a specialty.

Turbine catalogue or gear list mailed on application.

Correspondence solicited.

J. C. WILSON & CO.
Glenora, Ont.

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OAK LEATHER BELTING

Try our "CROWN BRAND" "DYNAMO," for Dynamos, Motors, Fans, Etc.

Cor. William and Seigneurs Streets, MONTREAL. -- *9 Jordan Street, TORONTO.*

THE STEAM TURBINE.

Mr. George Westinghouse on a recent occasion said : "The steam turbine is not a new and comparatively untried invention, as many laymen seem to think. There are half a million horse power of Parsons steam turbines in daily operation in different parts of the world ; eighty-four thousand horse power of these are in steam vessels. In the United States alone there are 60,000 horse power of stationary type used in connection with electric light and power in continual operation, and 150,000 horse power more are already contracted for and are now under construction at Pittsburg, where units as large as 8,000 horse power are being built. The impression in the public mind that the steam turbine is a new thing, is probably due to the fact that attention is frequently called to new makes of turbines."

ELECTRIC LIGHTING AT OTTAWA.

The city of Ottawa recently invited tenders for a renewal of the electric lighting contract. For a ten year contract, with privilege of cancelling it at any time on giving two years' notice, the Ottawa Electric Company offered to supply arc lights at $52.01 per lamp per year. Should the city only give a five-year contract the price would be $56.94 per lamp.

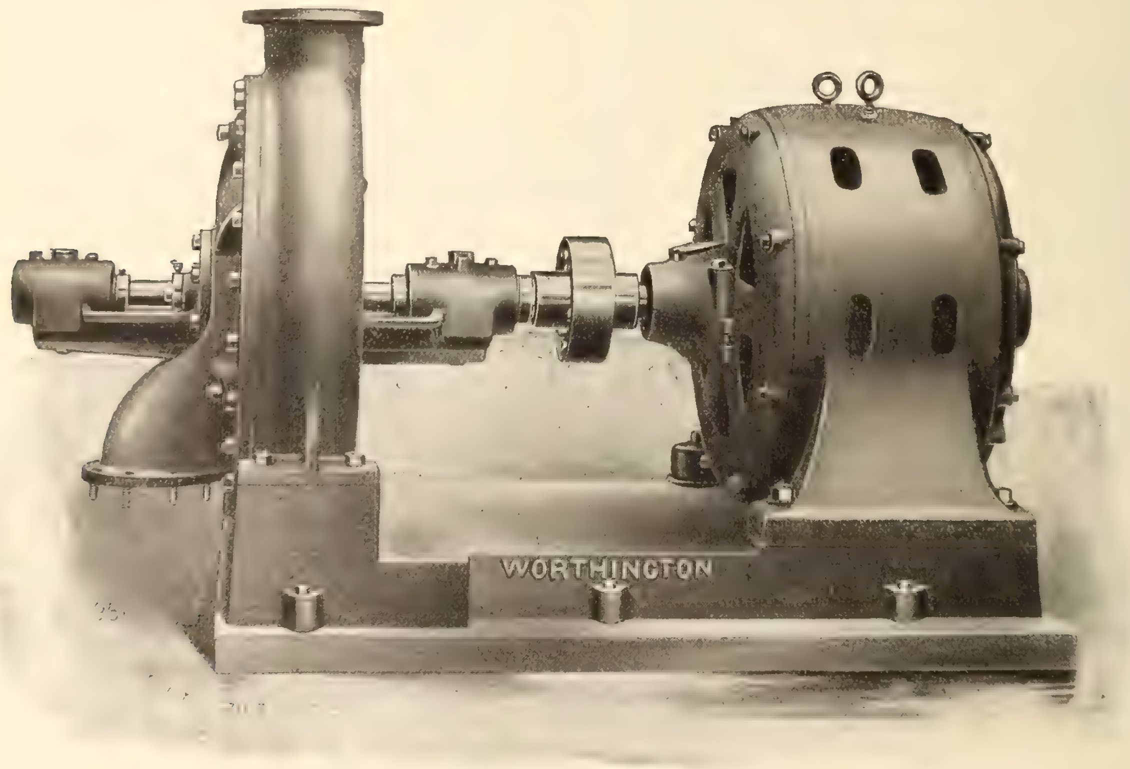
The Council also asked for tenders for the supply of current should it be decided to establish a civic plant. The Consumers' Electric Company offered to supply the necessary power at $14.75 per horse power for five years, and $14.25 for ten years. This company advised the Council that they were not in a position to tender on the lighting of the streets, as the regulation that they must keep their wires three feet from the wires of another company would make it unprofitable to carry wires to some points where light is desired. The Fire & Light Committee recommended that the contract for the supply of power be given to the Consumers' Company at the price named above, and that steps be taken to install a civic plant for the purpose of distributing the current.

The City Council, however, by a vote of 15 to 8, decided on May 16th to renew the contract with the Ottawa Electric Company for a period of ten years at the rate of $52 per lamp per annum.

OPENING AT WINNIPEG.

Mr. G. A. Powell, sales manager of the Packard Electric Company, Limited, of St. Catharines, leaves in a few days for Winnipeg to open a branch office for his company there. This step is necessitated by the vastly increasing trade of the company in the west. Definite arrangements have not yet been completed as to location, etc., but it is very probable that Mr. Powell will remain in charge of the Winnipeg office for some little time, at least until the organization is perfected. With a branch office in the east at Montreal and in the middle west at Winnipeg, the company is in an excellent position to care for the demands of their rapidly increasing business.

Messrs. McKay & Company, who have the contract for street and commercial lighting at Sydney Mines, N.S., are about to commence the construction of their power house. One hundred 32 c.p. incandescent lamps will be required for street lighting.



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SINGLE-STAGE **WORTHINGTON TURBINE PUMP**

Driven by an Induction Motor. Capacity 1,800 gallons per minute against 70 feet head.

The John McDougall Caledonian Iron Works Co., Limited, Montreal, Que.

SEND FOR CATALOGUE BUILDERS FOR CANADA

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Announce That They Have Taken Over the Business and Representation in Canada of the

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SPARKS.

The light committee of Westmount, Que., has unanimously recommended that the town should acquire the electric light plant.

Mr. Dion proprietor of the St. Louis hotel, Quebec, is installing an electric plant to supply electric light and to operate the elevator.

The electrical apparatus for the C.P.R. power house at Fort William, Ont., is being installed by the Canadian General Electric Company, and the engines by the Robb Engineering Company, of Amherst, N.S.

The Trinidad Electric Company, Limited, was operated last year at a net profit of $65,185.59. The passenger receipts were $95,005.95 and the light and power receipts $81,226.73. Operating expenses called for $75,445.86, and bond interest $36,000. The president states that the directors anticipate that when the additional four miles of track now under construction are completed, the receipts will be materially increased. During 1903 1149 new incandescent lights were added, the total in operation being 9,948. Operating expenses were 41 per cent. of the gross earnings. Mr. John F. Stairs, of Halifax, has been re-elected president.

The Bell Telephone Company have recently completed the additions and improvements to their exchange on Temperance street, Toronto. The new switch-board which has been installed is capable of accommodating 9,600 lines, and at present is arranged for 6,400. It is of the common battery type, the most improved system for central office operation yet devised. The North and Parkdale exchanges had already been equipped with this system, so that the entire city is now served by the improved method which does away with the ringing of a bell to call central. The Bell Company are gradually taking steps leading to an entire underground system in Toronto. All the new extensions are being placed underground, the length of the present ducts being nearly 700,000 feet. There are two miles underground to every one overhead.

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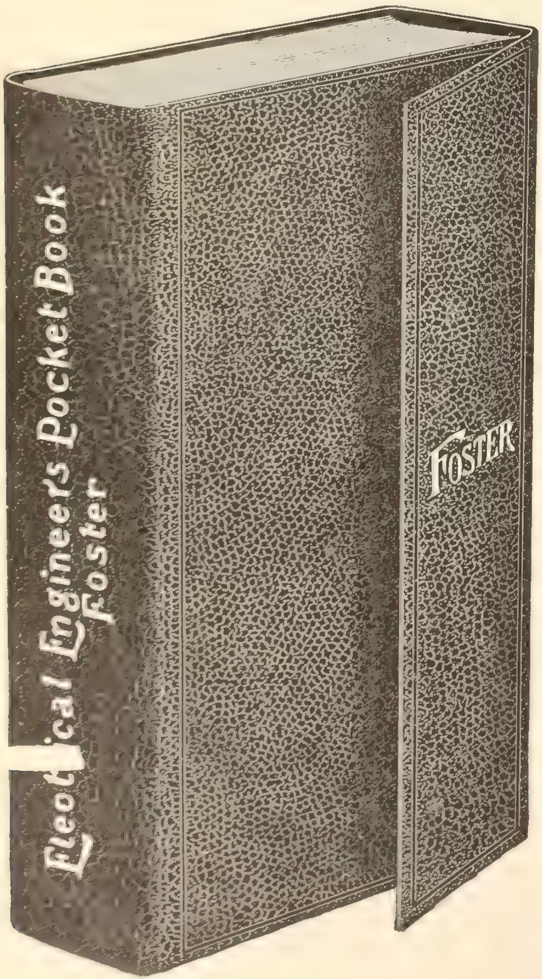

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An index to the contents means too much space here. An index will be sent on request.

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SPARKS.

The ratepayers of Barrie, Ont., are to vote on a by-law May 20th to raise money to install an electric fire alarm system.

The Dominion Government have poles and wire on the ground preparatory to building a telegraph line connecting Edmonton and Arthabaska Landing, N. W. T.; 100 miles of wire will be strung, and the line will be ready for use by September.

Mr. H. W. Kent, of Vancouver, superintendent of the Burrard Inlet Telephone Company, recently made an inspection of the proposed route of the new telephone cable to connect Victoria with the main land. He took soundings all along for the purpose of finding a suitable cable bed. The greatest difficulty likely to be encountered is the exceptionally deep water along the west coast of San Juan Island.

The suit brought by the Sandwich, Windsor & Amherstburg Railway Company against the town of Amherstburg, to recover a bonus of $10,000 voted by the ratepayers, has been practically settled. By the terms of the agreement the town will give a bonus of $6,000.

Several applications have been made to the New Brunswick Government to utilize the water power of Grand Falls, as the result of which an order has been passed granting the Electro-Manganese Company, of New York, until July 11 to make a deposit of $50,000 and enter into a contract for the development of the power. This is demanded as a guarantee that the company will proceed with its works for the reduction of bog ores.

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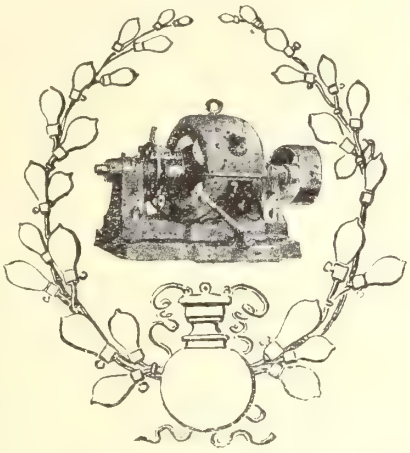

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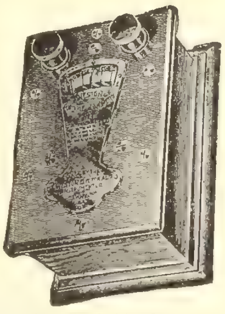

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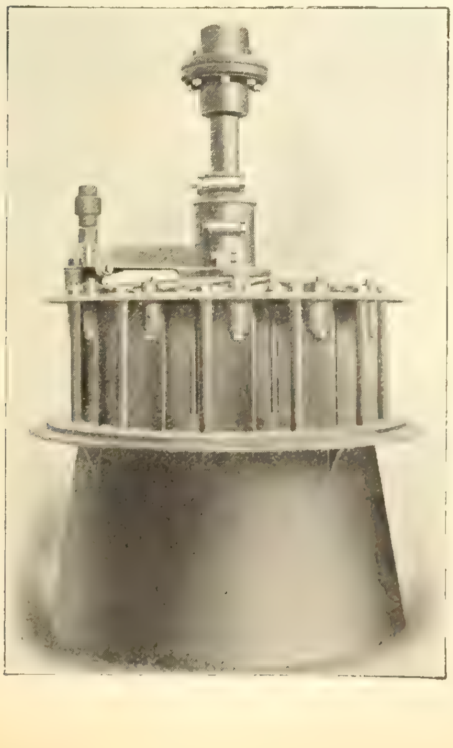

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SPARKS.

The Minnedosa Power Company, of Minnedosa, Man., have commenced work on the construction of a power dam.

The City Council of Nanaimo, B.C., are considering the construction of an electric railway connecting that city with Departure Bay.

The Ottawa East Waterworks Company, of Ottawa East, Ont., are building a new waterworks pumping station which will be operated electrically.

The John A. Lang Leather Company are building a large tannery in Ottawa, in which they will install an electric plant for lighting and power purposes.

The Petrolea Electric Light Company, Petrolea, Ont., want a new five-year contract from the town before they complete the proposed improvements to their plant.

It is stated that local capitalists of Fort William, Ont., purpose forming a company to build and operate an electric street railway in that town. It was thought that power might be obtained from the new C. P. R. power house, but on account of the Ogilvie Company already having entered into a contract with the C. P. R. for power, this may be impossible.

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SPARKS.

The Charlemagne Traction & Power Company has been incorporated by the Quebec Government to construct an electric railway in the counties of Terrebonne, Montcalm, L'Assomption and Berthier. Messrs. Greenshields, Greenshields, Henekler & Mitchell, of Montreal, are solicitors for the company.

Mr. E. S. Harrison, of Winnipeg, has organized the Alberta Electric Snpply and Construction Company, Limited, of Edmonton, N.W.T. The company is capitalized at $50,000 and purpose doing a general electrical supply and contracting business in Edmonton and the surrounding district. Mr. W. J. Richardson is secretary-treasurer of the company.

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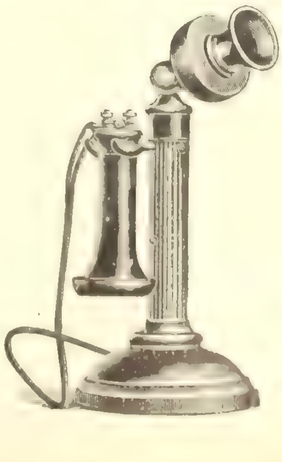

SPARKS.

The ratepayers of Kincardine, Ont., may vote on a by-law to raise $4,000 to improve the electric lighting system.

The ratepayers of Mitchell, Ont., recently carried a by-law to raise $10,000 for electric light and waterworks improvememts.

The Montreal Pipe Foundry Company intend equipping their entire plant at Londonderry, N.S., with electric light and power.

The C.P.R. Telegraph Company have placed an order with the Dominion Wire Manufacturing Company, Montreal, for 1,400 miles of copper wire, weighing 210 pounds to the mile.

Mr. Ackerman is still negotiating with the Town Council of Midland, Ont., for a contract for the supply of electric power. He proposes to develop a water power at Port Severn capable of producing upwards of 3,000 horse power.

The British Columbia Electrical Railway Company are building a new sub-station in New Westminster. It will be 60 x 33 feet, built on a foundation of 128 piles driven down to hardpan and cut off six feet below the steel level. On the top of these will be a concrete foundation nine feet in depth, and above this a floor consisting of steel rails two feet apart and a six-inch layer of cement. The walls of the building will be of brick and the roof of asbestos.

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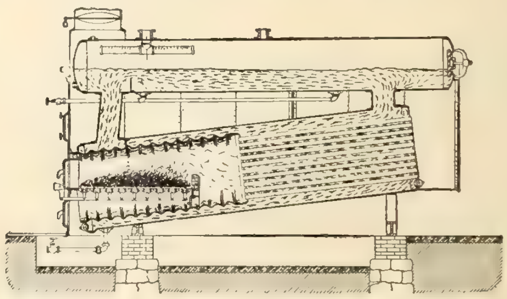

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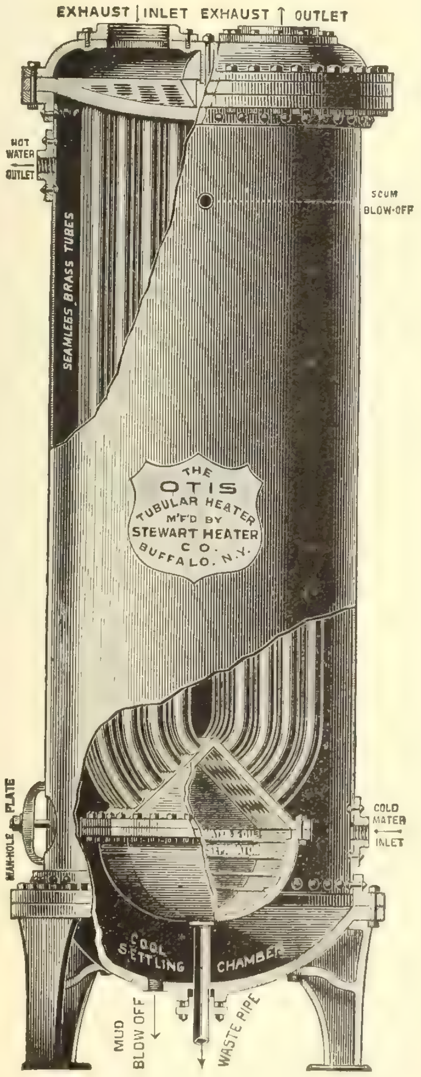

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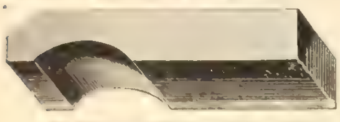
SPARKS.

The St. Johns Electric Light Company St. Johns, Que., will obtain their power from Chambly about July 1st, when they will be in a position to supply light and power night and day. They have reduced their rate to one-half cent per hour for 16 c. p. lamps.

The Electrical Construction Company, London, Ont., have been awarded the contract for engines, generators and switchboards for the new School of Science building on College street, Toronto. The boilers will be supplied by the Toronto Furnace Company, and W. J. McGuire will install the electric wiring.



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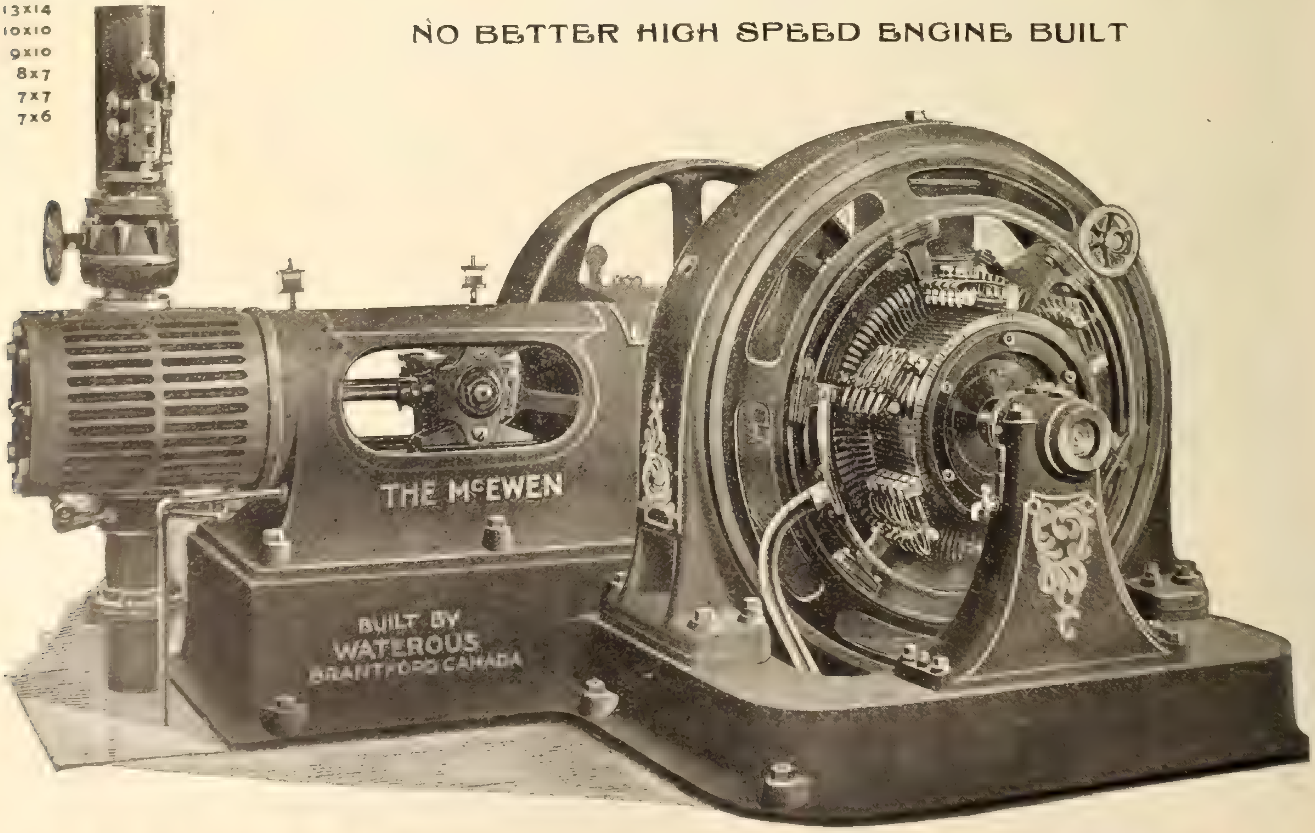
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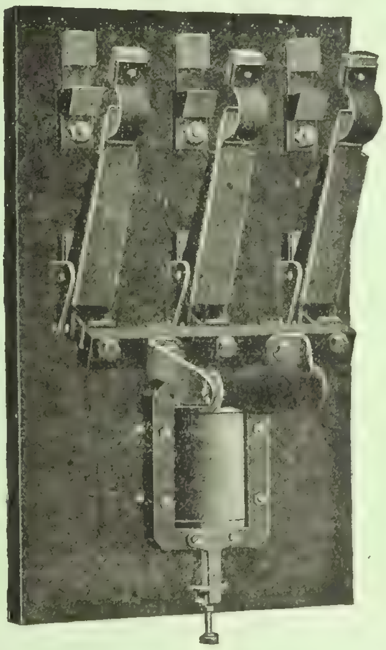

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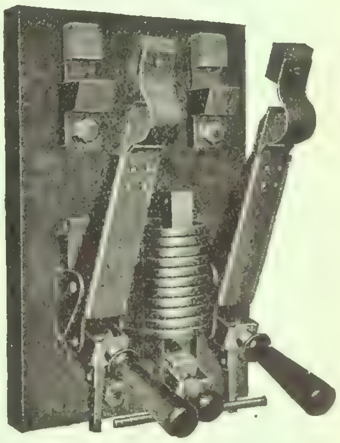

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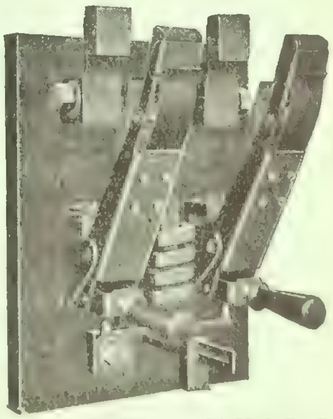

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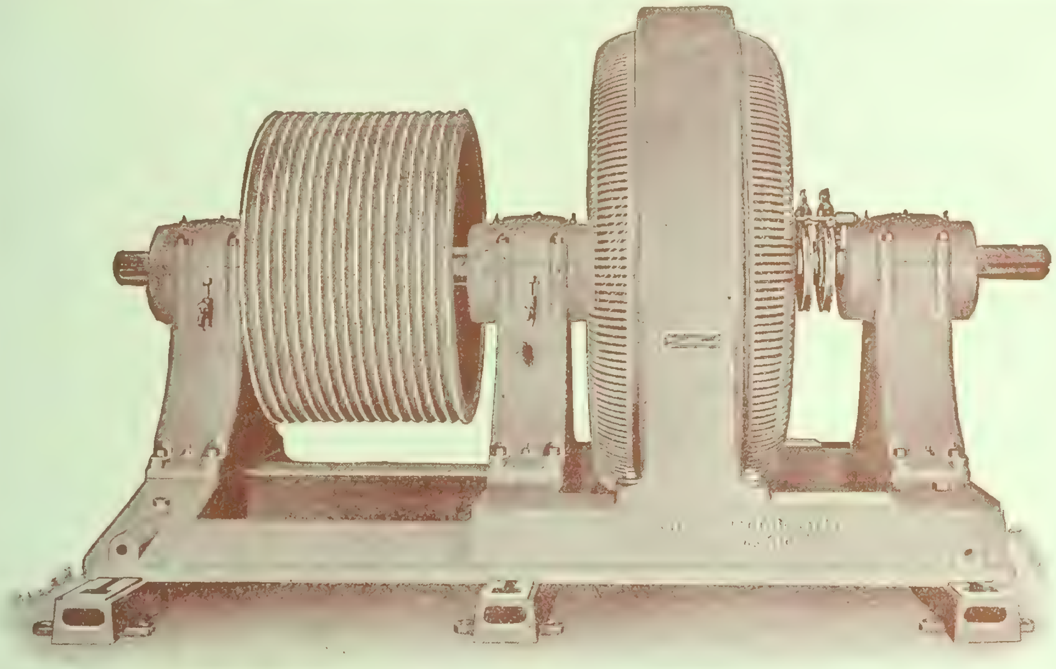

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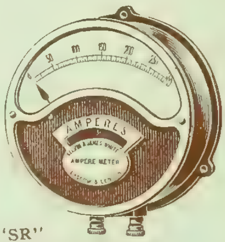

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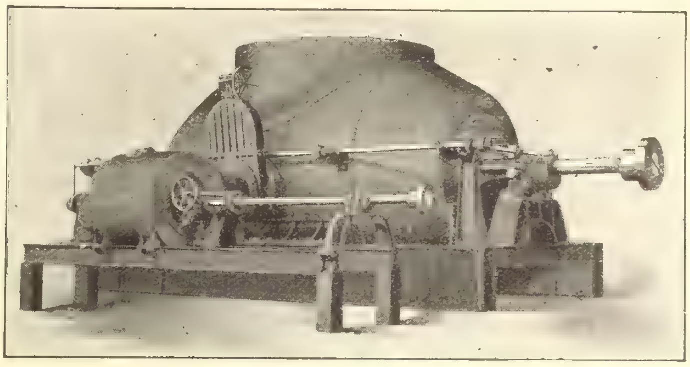

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SPARKS.

Mr. J. M. Campbell has been granted a franchise to transmit electric power to Kingston from Kingston Mills, where he will develop a water power.

The Singer Sewing Machine Company, who are building a large factory at St. Johns, Que., will probably install an electric plant for lighting and power purposes.

The street railway traffic in Toronto on Victoria Day last was the largest for any single day in the history of the company. The passengers carried, excluding transfers, numbered 255,554.

The Mount St. Louis Institute, Montreal, is installing an electric and gas plant for lighting and power purposes. A gas engine will be connected to a 25 k.w. Westinghouse generator. The wiring of the building is to be of enclosed steel conduit.

The Fredericton Gaslight Company, of Fredericton, N.B., have contracted with the Westinghouse Company for a new electric plant capable of supplying 4,500 16 c.p. lamps. The Robb Engineering Company, of Amherst, N.S., will supply a Mumford boiler and a Robb-Armstrong high speed engine of 300 horse power.

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SPARKS.

Mr. Goulet, formerly with the Northrop Iron Works, Valleyfield, Quebec, has been appointed head draftsman for the Canadian General Electrical Company, Peterboro.

Mr. George Montgomery, electrical engineer of the Jacques-Cartier Water Power Company, Quebec, has accepted a responsible position in the engineering department of the Montgomery Power Company, Montgomery, Alabama.

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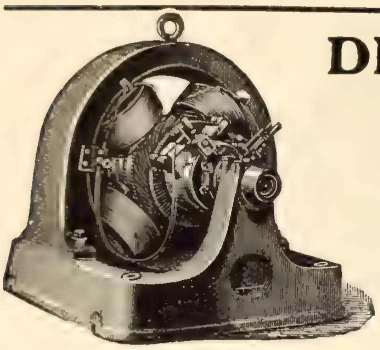

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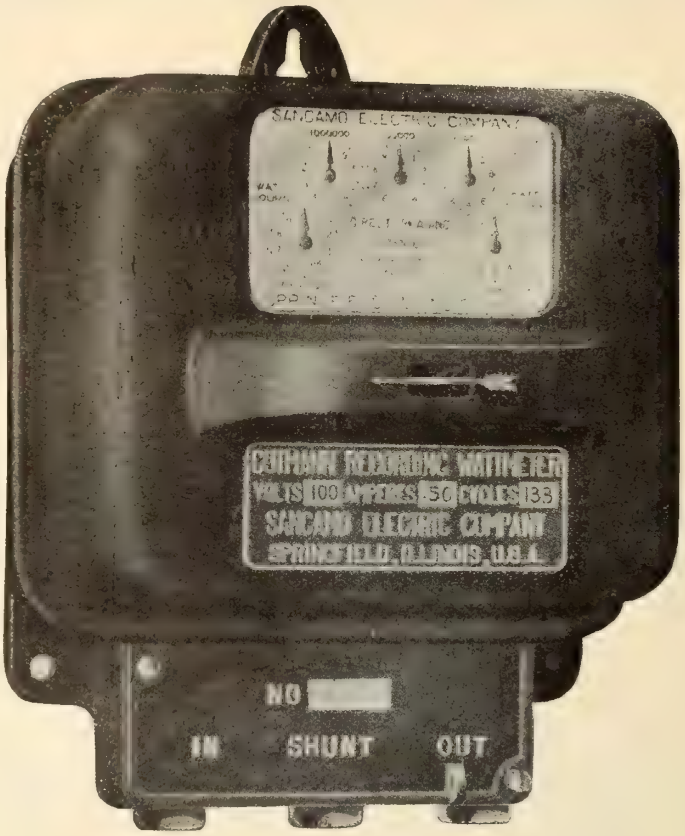
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SPARKS.

Mr. D. W. Kett has purchased the village electric light plant at Tilbury, Ont., from Mr. A. F. Nelson.

A special committee appointed by the City Council of Brantford, Ont., have recommended that a municipal telephone system be established.

Mr. S. Butler gave on May 18th an interesting talk on "Wireless Telegraph and X Rays" before Toronto No. 1, Canadian Association of Stationary Engineers.

The town of Waterloo, Ont., purpose taking over and remodelling the electric plant owned by Mr. William Snyder. Mr. H.F. Strickland, of Toronto, is acting for the town.

Mr. James Playfair has succeeded in compelling the town of Midland, Ont., to pay him some $5,000 for his electric light plant, in addition to the amount fixed by the arbitration.

Letters patent have been issued increasing the capital stock of the Central Telephone Company, Limited, Fredericton N.B., from $10,000 to $209,000, and extending the powers of the company to the whole province.

A paper on "Steam Turbine Testing at the Westinghouse Works," by Mr. A. G. Christie, was read before the Engineers Club of Toronto on May 26th by Mr. R. J. Dunlop. The mechanism of the turbine was illustrated by means of drawings and photographs.

Mr. G. Stuart Ross, son of Mr. H. G. Ross, of Vancouver, was accidentally killed at the Ashcroft's Water and Light Company's power house on May 13th. In endeavoring to stop a large gear wheel by placing a stick of timber through it, he lost his balance and fell beneath the timber.

The City Council of St. Catharines, Ont., on May 20th, gave a second reading to a by-law which provides that the city shall subscribe for $20,000 stock in the Niagara, Queenston, and St. √ Catharines Railway Company, which will build an electric railway from St. Catharines to Niagara-on-the-Lake, thence along the bank of the Niagara river to Queenston.

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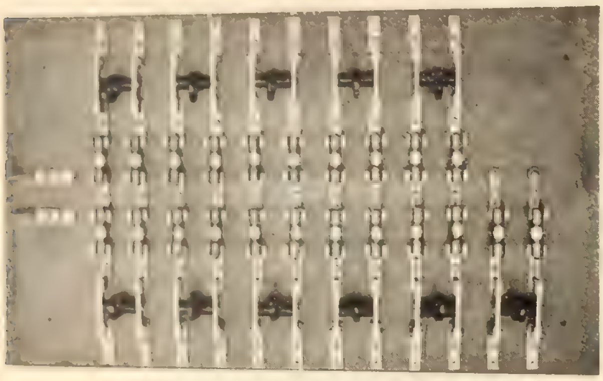

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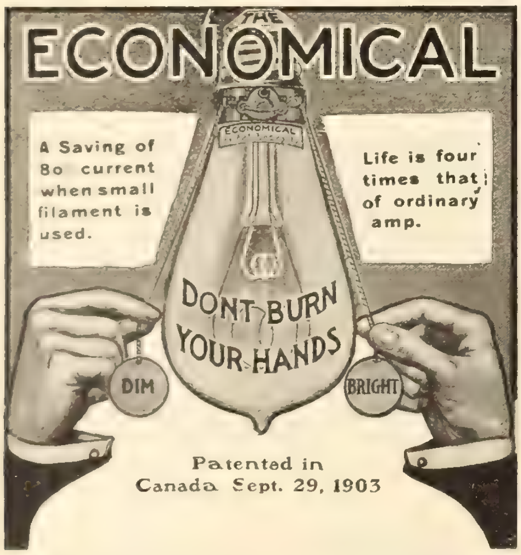
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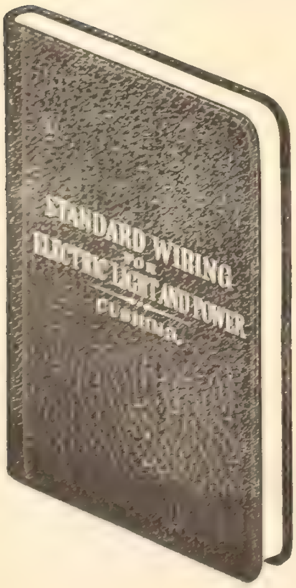

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CANADIAN
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VOL. XIV. JUNE, 1904 No. 6.

THE USE OF ELECTRICITY ON THE LACHINE CANAL.[*]

BY L. A. HERDT, A.M. Can. Soc. C.E.

The Lachine Canal is part of the large waterway which connects the great lakes with the Gulf of St. Lawrence. This waterway, comprising the mighty St. Lawrence River and the chain of lakes of the Canadian West, is, as regards the beauty of its shores, the grandeur of its scenery and the majesty of its falls, without any rival. But above all, as an inland water route, it is unsurpassed in the world for its commercial usefulness. Having a total length of 2,400 miles, 1,000 miles from the Atlantic Ocean to Montreal, the metropolis of Canada, and 1,400 miles to the head of Lake Superior, it allows free and safe navigation to large vessels up to fourteen feet draught.

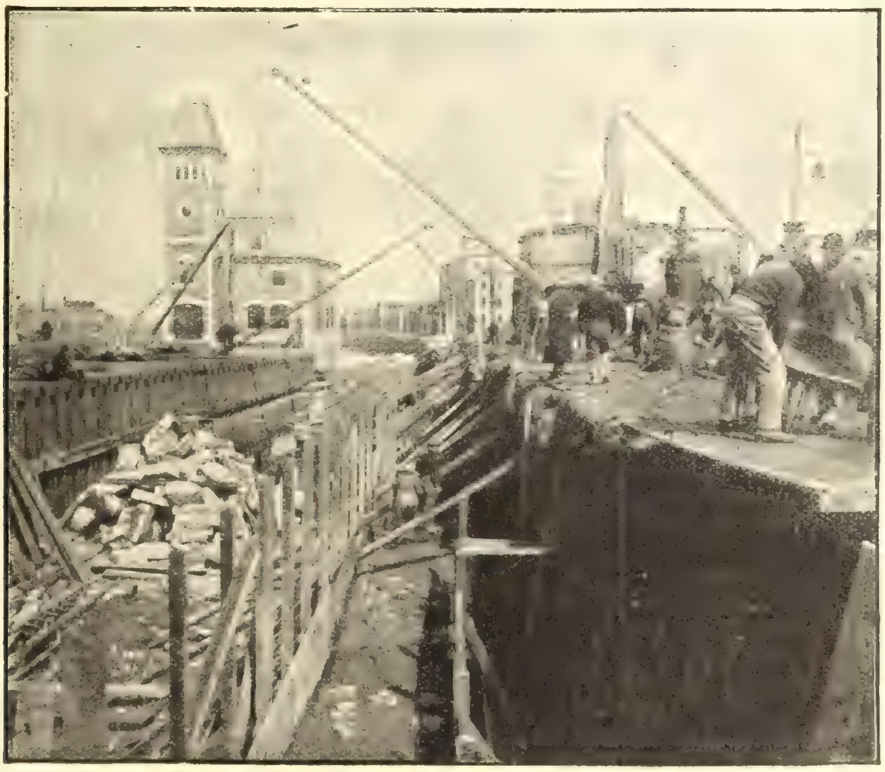


FIG. 1. EXTERIOR VIEW OF POWER HOUSE, LACHINE CANAL.

The St. Lawrence River, the canals and the great lakes, have become the great artery of commerce, serving to carry the freight of the West of Canada to Europe, besides supplying the local traffic of the cities, towns and villages lying along their shores. Such facilities for navigation, however, were not obtained without considerable outlay of money, of time and labor, also engineering works of the highest order. Among such works are to be included the magnificent system of canals, comprising the Lachine, Beauharnois, Cornwall, Soulanges and Welland canals. The aggregate length of these canals is 70¾ miles, with a lockage of 563½ feet, through 54 locks.

THE CANAL.

In the year 1903 the Lachine Canal was opened to navigation 246 days. During this time 7,365 vessels of all descriptions passed through it, carrying over two million of tons of freight and 35,000 passengers. 432,000 tons of wheat, 218,000 tons of corn, 22,000 tons of flour, 327,000 tons of lumber, 370,000 tons of coal and half a million of tons of general cargo passed through its locks.

A few words as to the history of the construction of the Lachine canal will not be out of place, especially as a complete history is yet to be published.

Immediately above Montreal are found the rapids Sault St. Louis, or Lachine rapids, which are the first obstruction to westward navigation in the St. Lawrence river. To continue the water route, as far back as 1700 the Sulpician Fathers opened a boat canal, merely a trench, via river St. Pierre in the marshes where the Lachine canal at present lies. The depth of the water was but two and a half feet, and served for boats to carry thirty barrels of flour. The locks were six feet wide and one hundred feet long. This was enlarged and deepened in 1821 to allow for navigation by barges drawing four feet. The locks were lengthened to one hundred and fifty feet and broadened to twenty feet. In 1843 a ship canal was begun at a cost of two million of dollars. Five locks were built, each 2,000 feet long and nine feet of water on the sills.

The length of the Lachine canal is eight and three quarter miles. From Lachine to Cote St. Paul, a distance of five and three-quarter miles, there are no locks, the Lachine locks being, in fact, only guard locks, the lockage is but a foot. From Cote St. Paul to Montreal harbor, a distance of three miles, the total lockage is forty five feet.

---

[*] Paper read before the Electrical Section of the Canadian Society of Civil Engineers, Montreal, March 24th, 1904.

The canal is spanned by six swing bridges built on piers of cut stone. These bridges are the Lachine bridges, Cote St. Paul bridge, Brewster's bridge, the Grand Trunk, Curran and Black's bridges. The last three are very heavy.

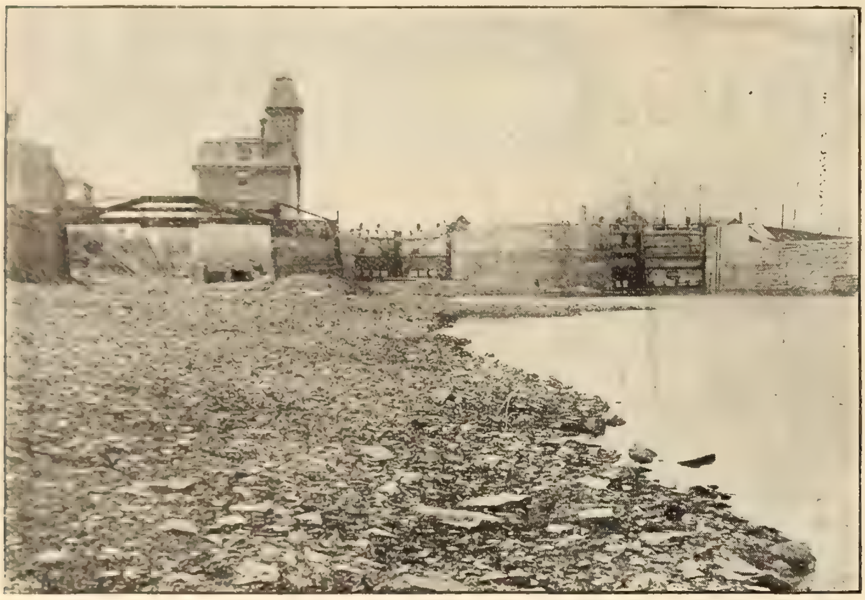


Fig. 2.—Rear View of Power House.

USE OF THE ELECTRIC POWER.

In 1902 the Department of Railways and Canals decided to take advantage of the avaliable water power on the Lachine canal to generate electric current for the following purposes:—

1st. To light the canal, the locks and approaches of the bridges.

2nd. To electrically heat the power house and lock cabins.

3rd. To open and close the lock gates, sluice valves and waste weirs.

4th. To operate the bridges spanning the canal.

To provide for these different services it was decided to provide the following equipment:—

For the lighting, 100 arc lamps, placed along the canal bank and at the locks, and approximately 100 16 c. p. incandescent lamps for lighting the power house and lock cabins.

For heating, six 6-kilowatts electric radiators, in the power house, besides a number of small heaters in the lock cabins.

For the operation of the locks, twenty-four 5 h. p. induction motors; for the bridges, four 5 h. p. motors.

The maximum station load due to these different services is far from their aggregate sum, as the different services are not required at the same time, and as all the motors cannot operate together. For instance, it would rarely happen that all the lock gates would operate together, and further with the arrangement of machinery described below, only half the motors, that is, two motors out of the four, per lock, can be working at the same time. The full capacity of the radiators would be required only in the winter months, at such time the canal is closed to navigation, the motors are not in operation and the lighting is limited to a dozen lamps which are required for the approaches to the bridges.

Proceeding from the assumption that all the purposes for which electric power is provided cannot take place at the same time, the size of the generator units was based on the following:-

100 arc lamps, four circuits of 25 lamps, 6.6 amps. per circuit, at 2,400 volts........ .... 63.5 K.V.A

Four locks out of the six in operation together, that is, 8 motors developing 4 h.p. each. Assuming the efficiency of motors, transformers and line at 70% and power factor 80%................ 42.5 K.V.A

Two bridges out of the four in operation together, that is, 2 motors developing 4 h.p. each, assuming same efficiency and power factor as above........... 10.5 K.V.A.

Heating of power house and lock cabins average..... 24. K.V.A.

A total of......... 140.5 K.V.A.

Two 75 K. V. A. generator units were considered amply sufficient to take care of this maximum load. During the day there would be no lighting, one generator could carry the power and heating load. At night the operation of both machines might be required but for a few hours, the night traffic being usually small.

HYDRO-ELECTRIC PLANT.

The power house is located at Cote St. Paul, on the south side of the canal. The working head of water is about eight feet. The water is drawn from the canal through a wooden flume 15 ft. by 11 feet, built in the Cote St. Paul overflow weir. Fig. 1 shows an exterior view of the power house, flumes and overflow weir under construction. The power house is a fine building of pressed brick, above a line of cut stone and concrete arches. Fig. 2 shows a back view of the power house, tail race and foundations.

Two 75 kilowatts, revolving field type A.C. 3 phase 2,400 volt, 60 cycle generators are belted to 7′ 8″ fly wheels. The latter are placed on two horizontal shafts geared to the vertical shafts of 125 h.p. turbines. The two horizontal driving shafts are in line so that they can be connected by a quill, allowing either generator to be driven by either one of the turbines. Fig. 3 shows the arrangement of machinery on the generator floor.

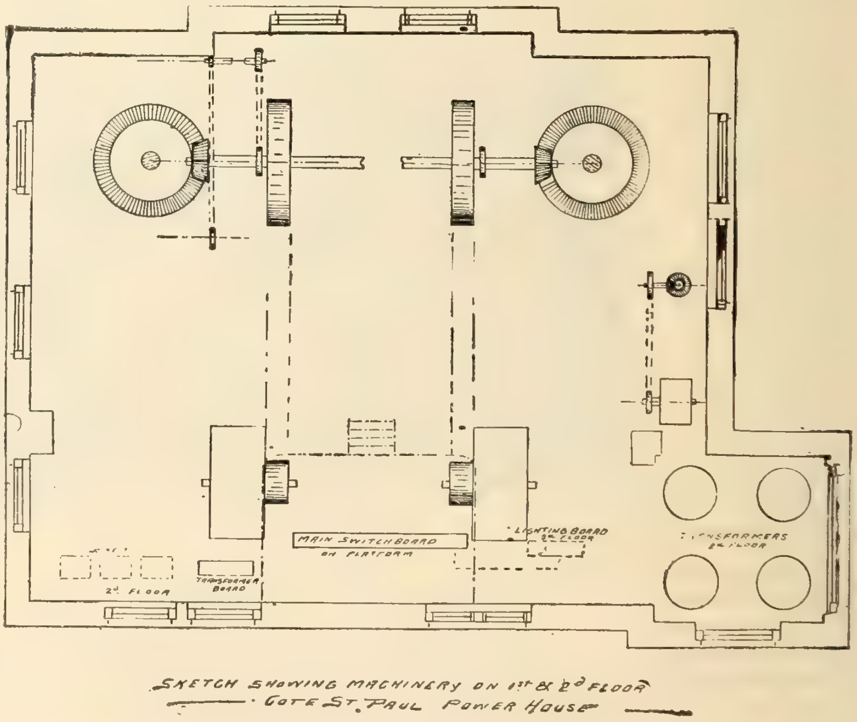

MAIN SWITCHBOARD ON PLATFORM
LIGHTING BOARD 2ND FLOOR
TRANSFORMERS 2ND FLOOR
2D FLOOR
TRANSFORMER BOARD
SKETCH SHOWING MACHINERY ON 1ST & 2D FLOOR
COTE ST. PAUL POWER HOUSE

Fig. 3.

One 7 5 kilowatt exciter is operated from a separate water wheel. It is of sufficent capacity to excite both generators when working under full load and 75% power factor. A spare exciter armature is kept in reserve.

SWITCHBOARD.

The switchboard is of the ordinary panel board form, comprising two generator panels, one exciter panel and one feeder panel.

This switchboard is placed on a gallery, eight feet above the generator floor. The generator panels comprise the necessary indicating ammeters, voltmeters and wattmeters. Oil type switches are used. A power factor indicator and frequency meter are placed in the circuit of each generator. The exciter panel has a D.C. voltmeter and two ammeters, one in the field of each generator, also carbon quick break knife switches for the generator fields. The feeder panel has an ammeter and high tension oil switch in each circuit.

The lighting of the switchboards and power house is done from a small transformer in the generator circuits, but it can be thrown on the exciter circuit if required.

ARC SWITCHBOARD.

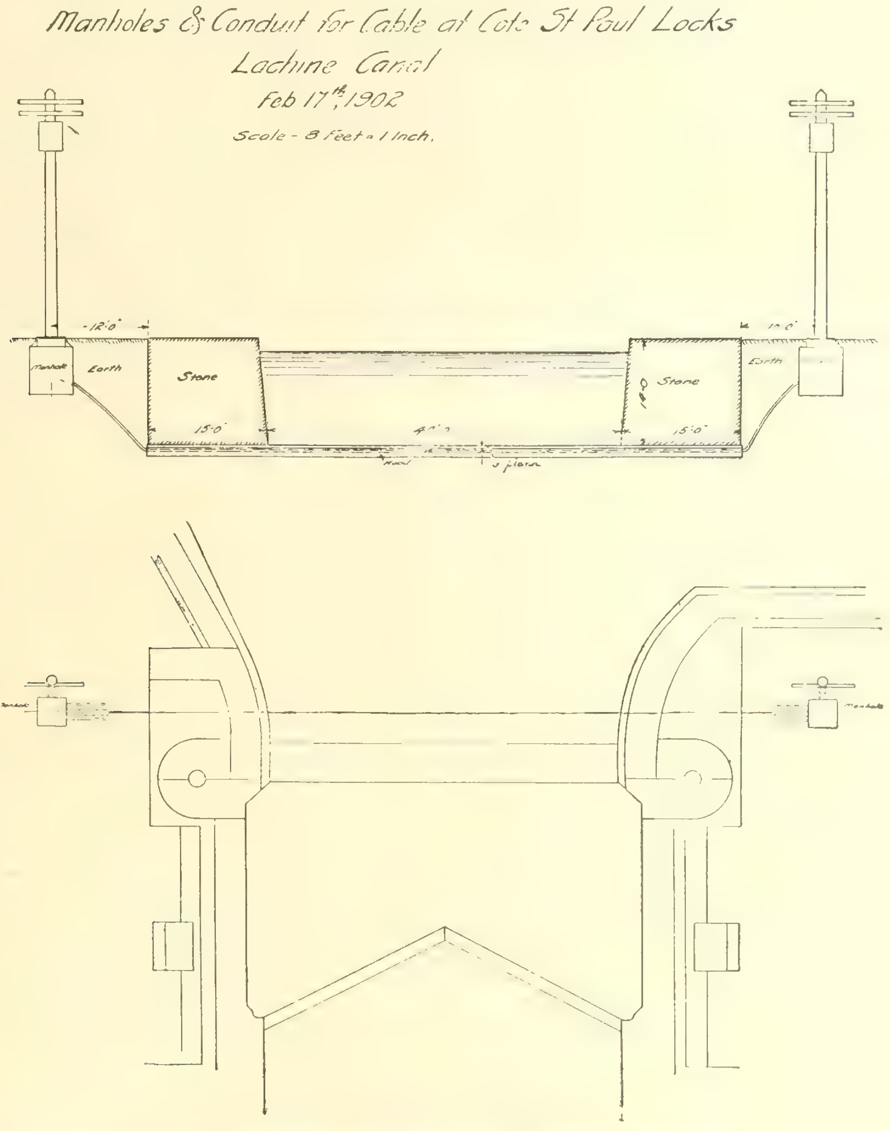


Fig. 5.—Showing Construction of Cable Crossings.

An arc switchboard is located to the left, on the second floor. Access to this board is obtained from the switchboard gallery. Four constant current transformers used for arc lighting are placed still further to the left, inside a square brick tower, three stories in height. The four arc light circuits, of 25 lamps each, are controlled by tubular plug switches which can be so connected that any arc lamp circuit can be connected to any one of the four transformers.

On the right of the main switchboard, on the second floor, is placed a board to control three 15 K.W. constant potential transformers for the electric radiators heating the building.

The cables from the switchboard are placed in conduits and run up against the walls of the brick tower to the top story, which is devoted to the lightning arresters and the distribution of the ends of the cables of the arms which support the transmission lines.

LIGHTING OF CANAL.

One hundred arc lamps, as stated previously, are distributed along the canal and at the locks for lighting. The lamps are spaced four hundred feet along the canal bank, that is a lamp on every fourth pole, these being one hundred feet apart. At bends the lamps are spaced to give proper illumination. Eight lamps per lock are used, giving decidedly brilliant illumination, and secured as safe navigation at night as in the day time. The series alternating current 6.6 ampere enclosed arc lamp is used, the regulating device being the floating coil automatic constant current transformer. The lamps are hung twenty-two feet above the ground, from brackets. The lamps can be carboned from the ground, as a small hand reel attached to the pole eight feet from the ground allows the lamp to be brought down, through a flexible steel rope running through the tubular arc lamp bracket. This avoids spiking the poles which in lines running in open country is undersirable.

POLE LINE CONSTRUCTION.

The pole line construction is substantial and somewhat artistic, the ornamental braces and brackets used giving it this appearance. Cedar poles painted white are placed one hundred feet apart, and six feet from the water edge, to clear the space for the tow path. Two six pin arms are used throughout, and double arms are placed on all turns these arms are bolted through the poles and at the ends.

On the side of the poles further away from the canal are carried the three phase 2,400 volt power circuit. One circuit runs west of the power house to Lachine Locks, a distance of nearly six miles. It is made up of three No. 4 B. & S. medium drawn bare copper wire. The wires are placed in triangular form 18" from wire to wire. A circuit running east to St. Gabriel locks, a distance of two miles, is made up of three No. 6 B. & S. wire.

On the side of the poles nearest to the canal are placed the arc light circuits. Three of these, each of two No. 6 B. & S. bare copper wires, run west of the power house. Each circuit connects twenty-five arc lamps in series. One arc light circuit runs east for the remaining twenty-five arc lamps.

The high potential lines for lighting and the 220 volt power circuits cross the canal at each lock in rubber insulated lead covered cables. These cables start from cable boxes placed on the poles, and run down the poles in iron conduit to manholes, and hence under the locks in pipe conduits. Fig 5 shows construction of cable crossings.

The cables can be drawn in or out at any time without delay. Spare conduits and cables are in readiness to change over if any cable shows signs of break down. The cable boxes on the poles also contain lightning arresters.

ELECTRIC HEATING OF POWER HOUSE AND LOCK CABINS.

Six electric radiators each of six kilowatts capacity operating under 220 volts are placed in the power house. These radiators have been in operation during the past winter and have been found sufficient to keep the power house very comfortable even in the coldest nights that have been experienced. As the load in winter is very light, the 36 kilowatts required for heating necessitates the running of only one generator.

Three 15 kilowatt transformers, one on each leg of the three phase, 2,400 volt circuit, are placed in the power house, stepping down to 220 volts, for the radiators. A switchboard with high and low tension switches is provided for this work.

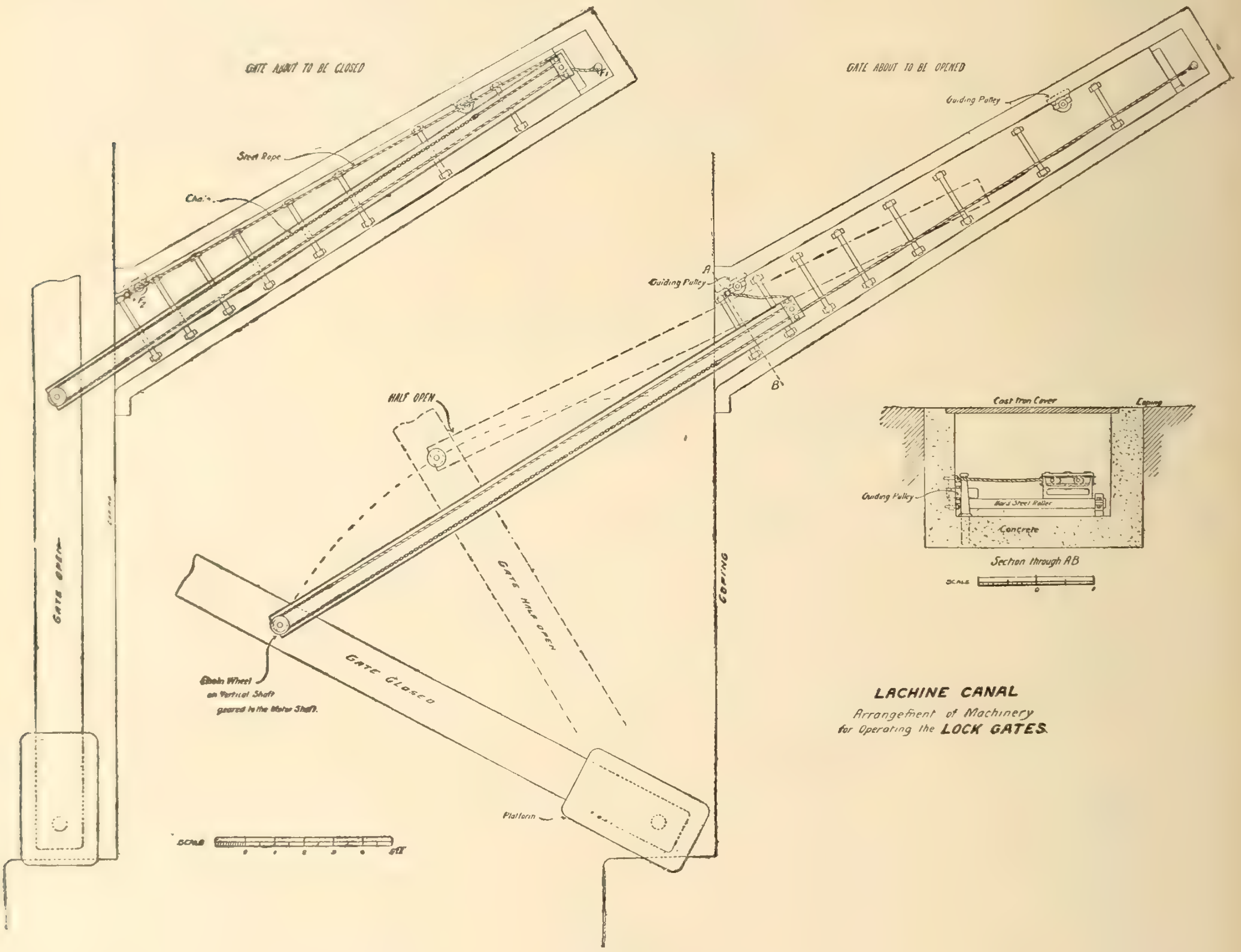


FIG. 6.

MECHANISM FOR OPERATING LOCK GATES AND SLUICE VALVES.

The old system of operating the lock gates and sluice valves by man power, does not require very long description. On the Lachine canal, four winches per lock are placed on the coping. By means of these winches, chains which open and close the gates are operated. This system is slow, over a minute and a half being required to open or close a gate; it is also expensive, as it requires, to perform the work at that rate, at least two men per winch or four men per lock. The sluice valves for filling or emptying the locks are on the gates and are operated from the gate platform through gearing lifting vertical rods or stems attached to the valves.

ELECTRIC POWER DRIVING.

In changing from the above method of operation to one employing electric power, the following conditions were to be fulfilled :

1st. The coping on both sides of the gates and the gate platform had, as far as possible, to be free of machinery.

2nd. One electric motor had to operate one gate, opening and closing, also raising and lowering the sluice valves on this gate.

3rd. A mechanism of such simplicity had to be employed as would avoid skilled labor.

4th. Operating staff had to be reduced to one man per gate, that is two men per lock.

In order to meet these conditions, the method to be described was devised by Mr. Marceau, superintendent engineer; Mr. Parizeau, of the engineer's staff, and the writer,and adopted. It might be stated in passing that a number of other methods could have been used, to do the same work, which, however, would not, we think, meet the specified conditions in the same complete manner.

The whole of the driving machinery for operating one gate and its sluice valves is placed on the gate, under the gate platform. (Fig 6.) The space there is rather limited, still it was found to be sufficient for the purpose. Power is supplied by a 5 H. P. three phase 220 volt induction motor running at 1,120 R. P. M. This motor is shown on the right hand of Fig 6. This motor is geared to a horizontial shaft, running approximately two-thirds the way along the gate. The speed of this shaft is 300 R. P. M. A reversing switch and starter, controlling the motor, will be placed close to the handles of the clutches, which operate the machinery. Three worm gears A, B C are placed on this shaft ; A and B to operate the two sluide valves, C to operate the lock gate.

MECHANISM FOR OPERATING SLUICE VALVES.

Gears A and B are loose on the shaft, but can be thrown in gear through friction cluches,these gears engage brass horizontal worm wheels, which in turning lift threaded stems or rods attached to the valves. The opening of the valves requires barely half a minute. A supplementary gearing enables the operator standing on the gate platform to open or close the gate valves by hand if the electric power fails.

Tests made on an experimental outfit last spring to ascertain the power required to open and close the valves gave the following results :—

Motor running shafting only..........	1,050 watts=1.4 H. P.
Opening sluices....................	1,500 watts=2.0 H. P.

Time required to open valve=30 seconds.

MECHANISM FOR OPERATING THE LOCK GATES.

A steel worm gear C running in oil is keyed to the horizontal driving shaft, and engages a horizontal brass worm wheel. This wheel rotates freely on a vertical shaft, which is the pivot for a U steel beam, resting on the gate on one side, and working in a cut provided in the coping at its outer end.

A friction clutch operated from the gate platform throws this wheel in gear with the vertical shaft, driving it at a speed of 15 R.P.M. A square brass casting, bored to fit this shaft and through which the latter passes, is placed in the web of the beam and holds it in place, allowing a certain amount of play whilst the gate is being moved. A chain wheel is keyed to the vertical shaft imparting motion to a chain and steel rope.

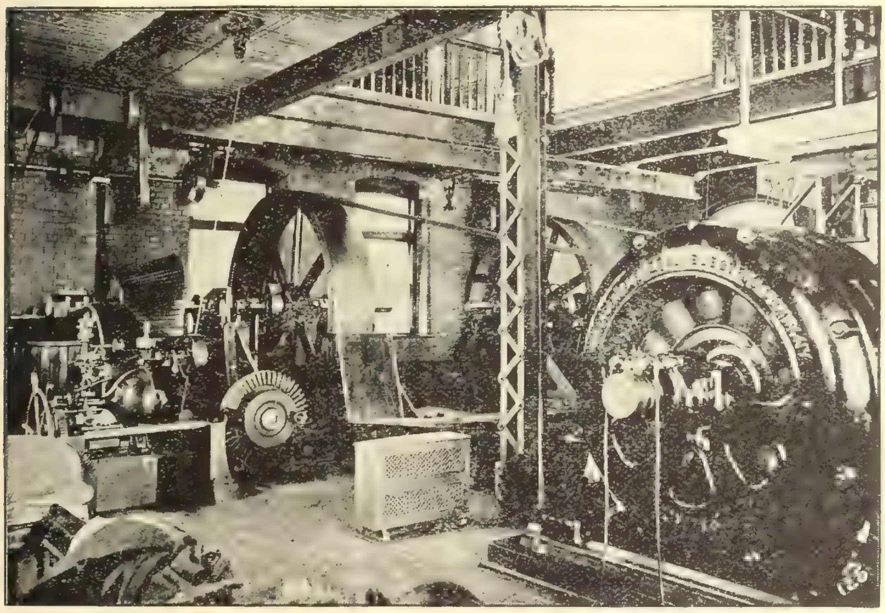


FIG. 4.—INTERIOR OF POWER HOUSE.

Drawing Fig. 7 shows three positions of beam with 1st, gate open; 2nd, gate half opened; 3rd, gate closed. The chain and rope after passing over the chain wheel run inside the web of the U beam, to guiding grooved rope wheels, placed at the outer end of the beam. The end of the rope is attached to two points in the cut made in the coping. One point F_1 is in line with the beam and at the inner end of the cut, the other point F_2 is near the edge of the coping. The beam is allowed to rest on hard steel rollers, placed on a bed of concrete slightly sloping towards the lock to carry away the surface water. An iron grating is fitted over this cut and allows inspection of the machinery at any time.

OPENING THE LOCK GATE.

To open the lock gate, the motor is started under no load except the friction of the shaft, in the direction indicated for opening. When up to speed, the friction clutch is operated, allowing a certain amount of slipping at the start to avoid sudden strains on the machinery. The chain wheel running clockwise will pull, through the chain and rope, on the point F_1, drawing in the beam towards the coping. The pivoting point P will describe the dotted circle shown. The outer end of the beam is guided by the rope in tension passing through the grooved pulleys until it reaches its position of rest at the end of its course. The gate is then open.

CLOSING THE LOCK GATE.

To close the gate, the direction of rotation of the motor is reversed, and thereby the rotation of the chain pulley, the rope tension is now on the point F_2, the beam will swing slightly as the rope becomes taut, until the beams rest on the guiding pulley shown on the left in the inner portion of the cut. The beam will then move out with the gate until the latter is closed.

It must be observed that in both the opening of the gate and the closing of it, the maximum pull is required at the start, and that this pull is directly along the axis of the beam whilst opening, and at a very small angle to it when closing, thus bending moments and abnormal frictional resistances are avoided.

The induction motor being up to speed when the clutch is thrown in, is able to develop its maximum torque. With the present reduction in gearing the pull on the chain is approximately 1,200 lbs.

With an average speed of chain of 28 feet a minute, the opening or closing of a gate will be done inside of a minute. Greater or lower speeds of operation can be obtained by a change of diameter of chain wheel.

Two operators will be required, standing respectively on the platforms of the gates. Through the friction clutches they will be in position to speed up or slow down, to allow the gates to come in well together.

Tests made with an experimental apparatus slightly different from the one described gave the following readings:—

Motor running shaft alone, 1,050 watts, 1.4 H. P.; starting to open gate, 3,200 watts, 4.42 H.P.; opening gate, 10 sec. from start, 2,500 watts, 3.3 H.P.; closing gate at start, heavy wind blowing against gate, 4,200 watts, 5.6 H.P.

The induction motors are 220 volt three phase motors. To step down the 2,400 volts of the transmission lines, three 5 K. W. transformers are placed on a pole at each lock. Lead covered cables run down the poles in iron pipes and then underground to the masonry walls of the locks to the gates at the pivoting point.

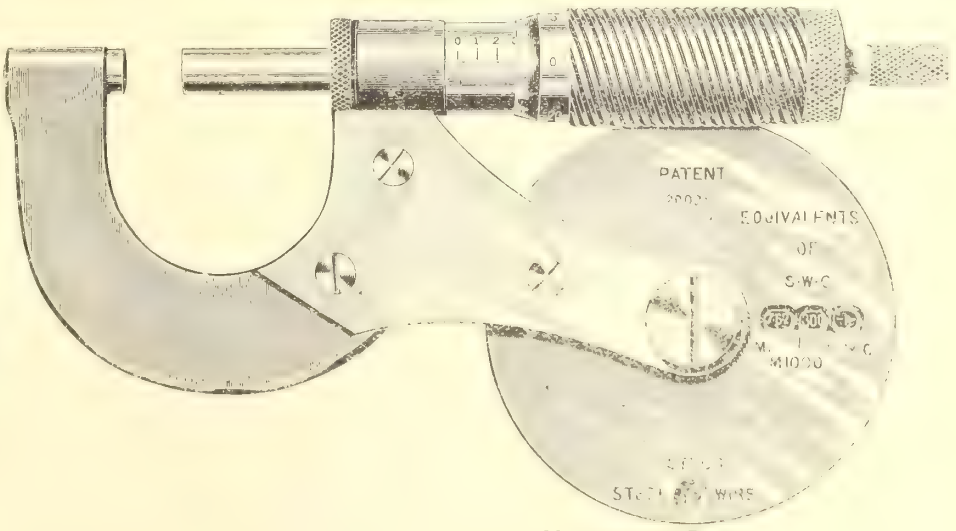
Only the lower voltage will be distributed about the locks.

BROOKER'S PATENT EQUIVALENTS MICROMETER GAUGE.

The gauge as shown in the illustration has, the manufacturers claim, many obvious advantages over the ordinary screw micrometer, as by means of the screw on hub and divided disc, readings can be taken up to .300 inch and 7.67 millimetres. On one side of the disc appears decimals of an inch, decimals of m/m and Stubs' round hole gauge, and on the other side 1/64-ths inch and imperial standard wire gauge.

The principal advantages claimed is that equivalents to gauges such as the Standard wire gauge, Stubs' round hole wire gauge, 64ths inch and metric measurements can be read off without the necessity of reference tables, and at the same time the jaws are set to the exact size in decimals. It will thus be seen that by turning the disc until any decimal or other number appears, several equivalents can be read. The whole of the micrometer is of steel, and of the finest London workmanship. The worm is cut on the hub and is of such form that it will not carry dirt or grit, and a new device for compensation for wear has been arranged, which is a great improvement on the old system, and dispenses with the necessity of taking out the screw and disengaging the worm.

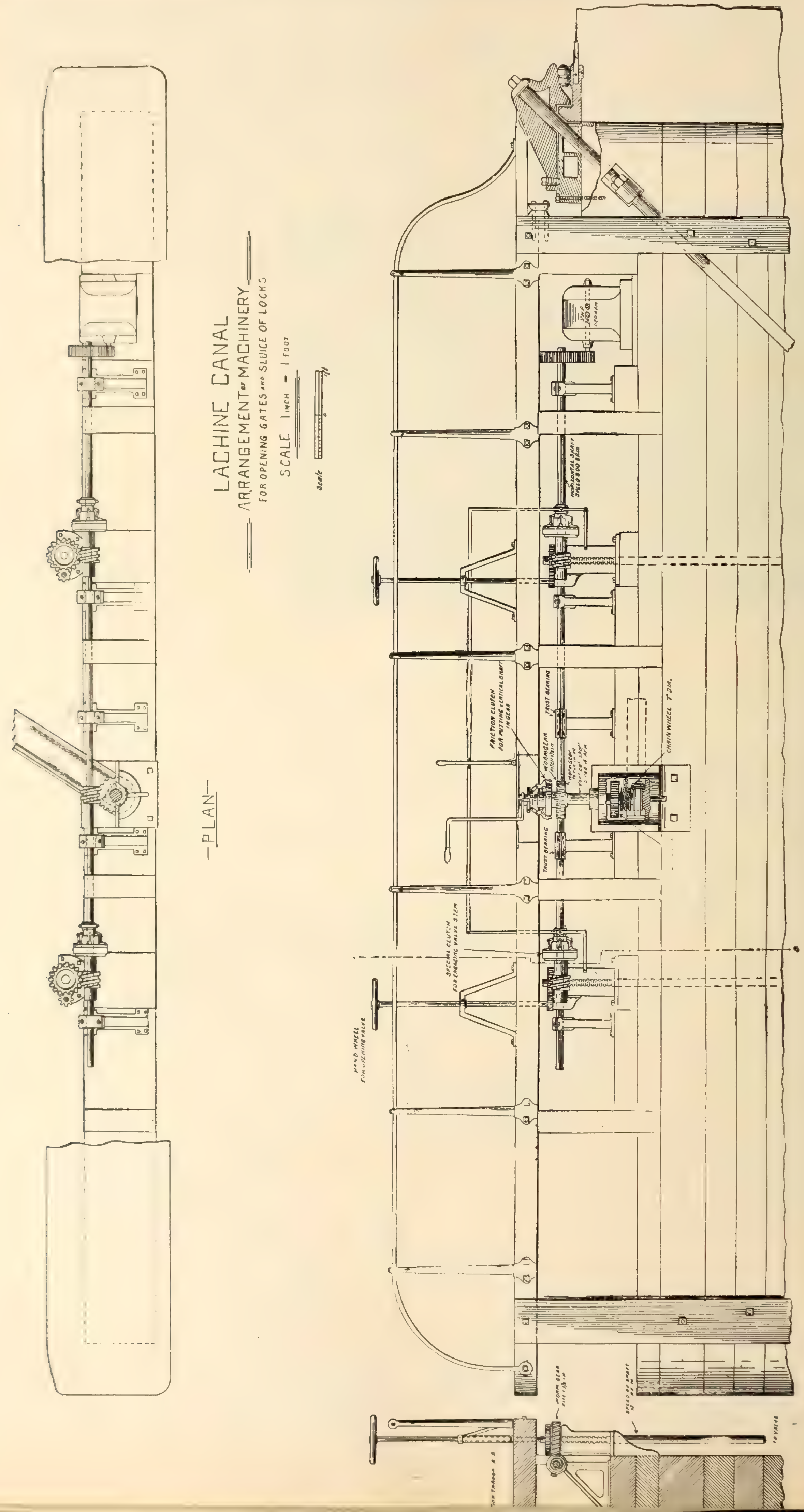
The revolving disc is of phosphor bronze, and only the smallest necessary portion engages with screw outside the cover. The hub is fitted with small milled thumb-piece, projecting beyond the ordinary hub, by means of which the speed of the screw is much accelerated. The anvil end of micrometer is flush with screw spindle, allowing of close callipering projections ledges, etc.



BROOKER'S PATENT EQUIVALENTS MICROMETER GAUGE.

Arrangements will be made to supply extra discs giving B.A. core and tapping sizes, Morse drill sizes or any other equivalents that may suggest themselves.

This gauge is manufactured by Brooker & Goss, Limited, London, Eng., for whom O. J. Parker & Company, 70 Bishopsgate street, Within, London, are sole export agents.


LACHINE CANAL
ARRANGEMENT OF MACHINERY
FOR OPENING GATES AND SLUICE OF LOCKS
SCALE 1 INCH – 1 FOOT
Scale
0
PLAN
ELEVATION
HORIZONTAL SHAFT SPEED 300 R.P.M.
FRICTION CLUTCH FOR PUTTING VERTICAL SHAFT IN GEAR
WORM GEAR
TRUST BEARING
TRUST BEARING
CHAIN WHEEL 7" DIA.
SPECIAL CLUTCH FOR ENGAGING VALVE STEM
HAND WHEEL FOR OPENING VALVE
WORM GEAR
SPEED OF SHAFT
TO VALVE

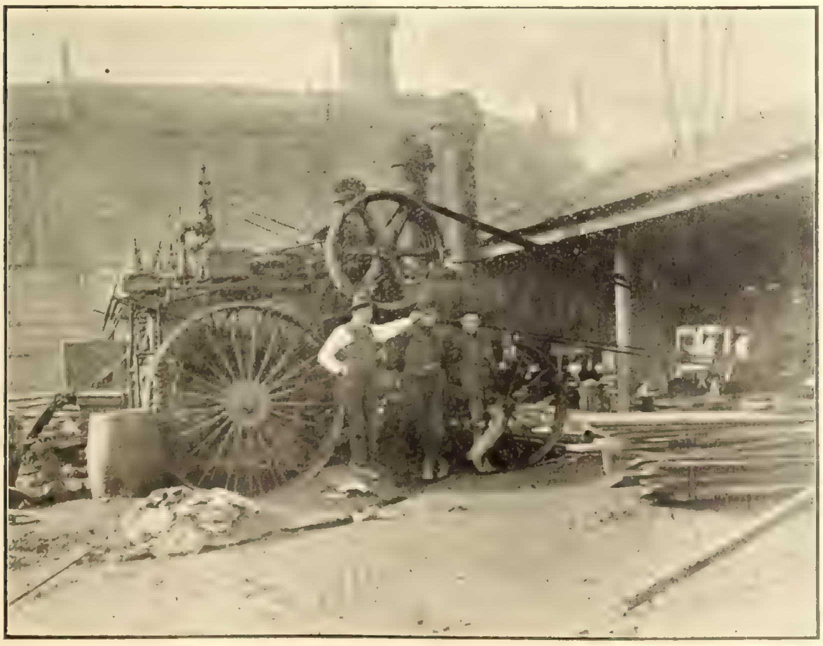
TEMPORARY ARC LIGHT STATION.

On March 14th last the city of Brantford, Ont., was thrown into darkness by the breaking away of the embankment of the canal, the electric plant being completely crippled thereby. It is beleived that the primary cause of the trouble was a colony of muskrats which had weakened the canal dyke by persistent gnawing. The head gates were at once closed to prevent the Grand river from flooding the city, and the canal was practically emptied. The break was about 60 feet long and 18 feet deep, and the thickness of the bank is about 100 feet at the base, sloping to about 20 feet at at the top. The first illustration shows the break in the bank, while the second illustration represents the temporary arc light station which the Brantford Electric & Operating Company were obliged to establish in order to continue the lighting service, which latter work, we think, breaks the record for rapid installation.

Break in Canal Bank, Brantford Electric and Operating Company.

The wash-out occurred at half-past four in the afternoon, and the makeshift plant was in operation and supplying some 200 arc lights the following night.

The motive power of the temporary station consisted of three Waterous engines which were backed in a yard close to an open shed convenient to their arc circuits. The arc machines were belted direct to the traction engines by making some changes in the pulleys. The shed afforded practically no protection from the weather, as it was open on three sides and there were several inches of snow and ice. However, the machines were raised up out of the wet, and supplied current as above stated.



Temporary Arc Light Station, Brantford Electric and Operating Company.

The accident no doubt cost the company a considerable sum, and Mr. Pratt, the superintendent, received great praise for the energy displayed in overcoming the unfortunate situation.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

The annual convention of the Ontario Association of Stationary Engineers was held at Brantford on May 30th last, when the following officers were elected: President, J. G. Bain; vice-president, George Fowler; treasurer, Charles Moseley; registrar, W. G. Blackgrove, all of Toronto.

Mr. Bain, the new president, has filled all the other offices in the gift of the association, and his election to the presidency is well deserved. As an engineer he is widely and favorably known, having held many responsible positions. He was in charge of the first electric plant installed in Toronto, and was for fifteen years in one position. About six years ago, owing to impaird health, he stepped out of the engineering field and accepted a position as traveller for a large oil company, in which line he has since continued. He is now a member of the staff of the Canadian Oil Company, Limited, which is an amalgamation of several independent oil companies, including the Grant-Hamilton Oil Company and the Sun Oil Manufacturing Company.

Mr. J. G. Bain,
President Ontario Association of Stationary Engineers.

In February last Mr. Bain was struck by a street car and received most serious injuries, his skull being badly fractured. Several eminent physicians entertained not the slightest hope of his recovery, but Providence ruled otherwise, and within two months he was sufficiently improved to leave the hospital and return to his home. A fortnight later, however, it was discovered that a second operation was necessary. This was successfully performed, and Mr. Bain is now almost fully recovered, and his many engineering friends are looking forward to the time when he will again be in harness.

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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OUR WINNIPEG OFFICE.

The publishers of this Journal have recently opened a branch office at No. 310 McIntyre Block, Winnipeg. A resident representative has been appointed who will be exclusively employed in advancing the circulation of this Journal and in keeping our readers informed regarding the latest developments throughout the west. The kind co-operation of our friends in the west is solicited in behalf of the suceess of this enterprise.

Developments in the Electrical Field.

The attention of electrical engineers on this Continent has been directed during the past year mainly towards the development of three different branches of the industry, and these three particular divisions are to-day receiving most careful attention. They are, the steam turbine, the development of alternating current motors for railway work, and high tension transmission engineering. These are subjects which have received the most attention from prominent engineers in the United States during the past year, and they are the subjects which come prominently before the Convention of the Canadian Electrical Association to be held in Hamilton this month. Although the steam turbine has been in use in different forms for a number of years, particularly on the Continent of Europe, it is only of recent years that it has been brought before the public as a prominent factor in the equipment of electric power houses, and considerable development has been necessary in order to adapt it for direct connection to electric generators. Although much has still to be accomplished in this direction before the steam turbine can take the place now held by the reciprocating steam engine, particularly for units of smaller size, there is no doubt that a great future awaits it; but this fact should be borne in mind by all who hold investments in electrical operating concerns, that the history of electrical development has been one of gradual evolution, not revolution, and that the time taken by the development of all important improvements is an insurance against any great loss due to the necessity for substituting new and improved apparatus for that which is already installed. From time to time the investing public is startled by reports of some new invention that will entirely revolutionize the industry and render practically useless the appliances already in vogue. Such revolutions, however, have never taken place, and while progress and improvement is constantly going on, and we all hope will continue to go on, it is we think on the whole fortunate that such progress and improvement is gradual.

This applies equally well to the impending advent of the alternating current single phase railway motor now being rapidly brought to the front. Naturally, the first railways to be equipped with such a system will be new railways, and railways so situated in every way as to render them favourable subjects for care and experiment by the manufacturers placing such apparatus upon the market. The importance of the introduction of the single phase railway motor, however, seems to lie in the fact that it presages the possibility of the adaption of electric traction to the trunk railroads. In the development of alternating current apparatus for railway work, progress would seem to have been retarded by a tacit assumption that the railway motor of the future would be one without a commutator, and electric railway men have been eagerly looking forward to the day when they would be granted this blessing; but now it would seem that the hope of the alternating current railway engineer is based on a motor with a commutator. This would appear to be all the more certain from the fact that induction motors, entirely without commutators, have been exploited, both on the Continent and in America, by the most capable engineers in the world, in an endeavor to produce a satisfactory equipment for railway purposes, but it must be admitted that these efforts have not resulted in any pronounced success. While this work has been going on, the quality of direct current apparatus has been improving all the time, until to-day the commutator is not the terror to railway men that it was even five years ago, and we believe that when the single phase commutator motor comes upon the market, as it undoubtedly will, it will be received without those misgivings which would have characterized its reception a few years ago, when the introduction of the "Squirrel Cage" induction motor was hailed with delight. We are glad indeed to know that we are to have an opportunity, at the forthcoming Convention, of getting further light on the development of this important piece of apparatus.

The subject of long distance transmission at very high voltages is only now receiving due attention, and during the past year or two, transmission systems, entirely aside from the question of power house and sub-station equipment in themselves, have taken a place as a separate branch of electrical work, to be studied and directed by men particularly qualified for such duties. The establishment, by the American Institute of Electrical Engineers, of a committee to collect data from all possible sources and to present it in proper form for consideration by the engineers of this continent, has given a great impetus to this work and will result, we feel sure, in a wonderful improvement not only in the reliability of long distance lines, but also in the methods for handling these circuits to the best possible advantage and for maintaining good regulation. It has already been demonstrated by the data collected from transmission lines located in all parts of the country, that conditions differ so widely that results which appear at variance with principles already laid down and apparently understood, can be reconciled when all the circumstances of the particular cases are taken into account. This emphasizes the importance of not only observing certain phenomena, but also the exact conditions and circumstances under which these phenomena take place. Since, as far as we know, comparatively few of the men associated with transmission enterprises in Canada are connected with any of the local branches of the American Institute, we would suggest that the subject should be brought to the attention of the delegates to the Convention, with a view to their co-operating with the local branches at Toronto and Montreal, unless the Canadian Electrical Association should see fit to establish a committee to collect data of the kind referred to in Canada, a country so favorable to the development of long distance transmission enterprises. It is true that numbers of the men directing and operating such systems meet together at the Convention and exchange to some extent their experiences, but the thing is to get all these experiences in some concrete form when it would be available for reference to the members of the electrical fraternity at large. We think that a favorable opportunity for bringing this matter before the Association will be offered when the discussion on the Toronto-Niagara transmission project takes place this week, when we trust the matter will receive the attention which it deserves.

Aside from the aspect of the subject referred to above, the question of design and construction of these lines is a most important one, and it would seem at last that the extreme conservatism in clinging to old methods would be abandoned and transmission systems constructed upon a proper scientific and engineering basis with due and particular regard to the particular case under consideration. We hope that in the discussion of the transmission paper all of the considerations weighed in deciding the different features of construction will be brought out and the reasons for adopting any special features given.

NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

Space will permit only brief reference to the important convention of the National Electrical Light Association held in Boston last month. Over one thousand persons were registered, making it the largest convention yet held. The address of President Charles L. Edgar contained many valuable suggestions. He pointed out that owing to the consolidations that had taken place it had been difficult to maintain the numerical membership of the association. The remedy suggested was to have another class of membership, consisting of individuals called junior active members, to be elected under some sort of supervision of the active member with whom they are connected in business and paying as dues an amount in keeping with their privileges. He called attention to the sudden and large business that developed last winter in electric thawing of water pipes, and suggested the appointment of a committee to collect and distribute to members the experiences of the various companies in this respect. He thought the field for the sale of electrical energy was comparatively unexploited. In not a single city of the United States had the possibility of the industrial-power business been fully developed, much less exhausted.

Numerous papers were presented, including the following: "A Three Wire 500-Volt Lighting System", by W. I. Barnes, Providence; "The Luminous or Flaming Arc", by W. E Homes, Newton, Mass; Standard Rating of Incandescent Lamps", by Dr. Bell; "Grounding the Neutral of High Voltage Generators", by George N. Eastman, Chicago; "Lost and Unaccounted-for Current", by C. W. Humphery, Denver; "Electric Heating", by James I. Ayer, Boston; "Economy in Minor Station Supplies", by Edgar B. Greene, Altoona, Pa; "The Gas Engine for Central Station Service", by E. E. Arnold, Pittsburg; Practical Notes on Steam Turbines", by Francis Hodgkinson, Pittsburgh; "The Mechanical Stoker and the Human Operator", by Edwin Yawger, Pittsburg; "Proposed System of Standard Instruments for Operating Companies", by J. P. Davis, Pittsburg; "Single Phase Power Motors for Electric Lighting Stations", by W. A. Layman, St. Louis; "Electric Light and Power Plants in Connection with Ice Plants", by C. L. Wakefield, Dallas.

Mr. E. H. Davis, of Williamsport, Pa, was elected president.

The Canadian delegates present included Messrs. W. McL. Walbank, R. S. Kelsch, J. A. Burnett, and R. M. Wilson, of the Montreal Light, Heat & Power Company; H. G. Nicholls, E. D. McCormack and A. B. Lambe, of the Canadian General Electric Company, Toronto; J. Murphy, of the Ottawa Electric Company, and G. Hartmann, of Quebec.

Canadian Electrical Association Convention

Headquarters, Royal Hotel, Hamilton.

PROGRAMME

WEDNESDAY, JUNE 15.

10.15 A.M. Meeting of Executive Committee.

10.45 A M.—Welcome by Mayor on behalf of Citizens of Hamilton.

11.15 A.M. to 12.45 P.M.—Opening Session.

2 P.M. to 5 P.M.—Business, Papers, and Question Box.

7.45 P.M. to 10 P.M.—Papers.

THURSDAY, JUNE 16.

9 A.M.—Street Cars to Victoria St. Sub-Station, thence to Deering Works and Westinghouse Works, returning to Headquarters at 11.15 a.m.

11.15 A.M. to 12.45 P.M.—Papers.

2 P.M. to 6 P.M.— Papers, Question Box, Election of Officers and Unfinished Business.

8.30 P.M.—Annual Banquet.

FRIDAY, JUNE 17.

8.10 A.M.—Street Cars to G.T.R. Station.

8.30 A.M.—G.T.R. to St. Catharines, thence by Conveyances to DeCew Falls. Luncheon in Power House 11.30 to 12.30, Conveyances to G.T.R. and train at 1.21 p.m. to Niagara Falls, thence by International Traction Co. to Power Works on Canadian side of River, returning to G. T. R. Station at 4.45, thence G.T.R. at 5.05 p.m. to Hamilton.

For the freedom of the Hamilton Street Railway and the visit to DeCew Falls and Niagara Falls, the Association is indebted to the courtesy of the Hamilton Cataract Power, Light and Traction Company.

C. E. A. Buttons will be accepted as passes on the Hamilton Street Railway, Grand Trunk Railway, and International Traction Company for Excursion to Niagara Falls. Buttons can be procured from the Secretary on registration and payment of annual dues.

Banquet tickets can be securdrom the Secretary.

LIST OF PAPERS.

"A. C. vs. D. C. Arc Systems", by W. L. McFarlane.

"The Origin and Development of Storage Batteries", by E. B. Walker.

"Aluminum Wire as a Conductor," by R. J. Parke, E. E.

"The Curtis Steam Turbine", by Frank C. Smallpiece.

"Statistics of Canadian Progress in Electrical Applications", by George Johnson.

"Heavy Electric Traction by Alternating Currents", by P. M. Lincoln.

"The Niagara Power Development", by K. L. Aitken.

The above programme justifies the anticipation that the fourteenth annual convention of the Canadian Electrical Association, to be held in the City of Hamilton June 15th, 16th, and 17th, will mark another forward step in the history of that important body. All indications point to a most successful meeting. There promises to be a large attendance, and the papers are of a character to guarantee lively and profitable discussion.

The Local Committee is composed of Messrs. J. G. Henderson, P. J. Myler, J. A. Kammerer, W. C. Hawkins, John Patterson, N. S. Braden, H. A. Moore, and J. W. Campbell. The personnel of this committee is an assurance that the entertainment features will provide ample opportunity for enjoyment. A welcome worthy of the city will be extended by His Worship Mayor Morden. Thursday evening will be given up to a banquet at the New Royal Hotel, which is expected to equal if not eclipse all former events of the kind. The business sessions will close on Thursday, leaving Friday to be devoted solely to trips of inspection to The Hamilton Cataract Power Co.'s interesting plant near St. Catharines, and the great power development works on the Canadian side at Niagara Falls. A special train will carry the party to these points.

Bird's Eye View of Hamilton.

City Hall, Hamilton.

FACTS ABOUT HAMILTON.

There is a great deal in and around Hamilton to attract the visitor, and the electrical man in particular. The location of the city is picturesque, being upon a plain that rises gradually from the shores of Hamilton Bay, a beautiful harbour at the western end of Lake Ontario. From the summit of the mountain a magnificent view of the city is to be had. Separating the lake and bay is Burlington Beach, Hamilton's favorite summer resort. It is intersected by a canal, which affords an entrance for the largest lake going vessels. Over this canal the Grand Trunk Railway have erected a new swing bridge, one of the largest single span swing bridges in the world, being nearly 400 feet in length. The Hamilton Radial Electric Railway use an electric swing bridge, which also accommodates vehicles and foot passengers.

From an aesthetic standpoint Hamilton stands in the front rank. One of the prettiest spots is Dundurn Park. It presents a delightful view of the water front on both sides of the bay, the Beach and its summer residences and hotels, and of Lake Ontario as far as the eye can see. This park contains thirty-two acres. Gore Park, which is located in the heart of the city, is brilliantly illuminated at night with a thousand or more colored incandescent lights, presenting a beautiful appearance.

The Incline Railway, Hamilton.

The sewerage system of the city is one of the most complete to be found anywhere. There are about sixty miles of sewers flowing into two sewage disposal works situated on the bay shore, the sewerage being treated by means of a process of chemical precipitation. The cost of establishing these works was about $100,000, and the annual cost for maintenance and operation is about $18,000. The waterworks system is owned and operated by the city. Water is taken from Lake Ontario nine miles from the city, the pumping station and filtering basins being located at Burlington Beach. The pumping capacity of the plant is about 15,000,000 gallons every twenty-four hours, and there is laid throughout the city about 110 miles of mains. The total cost of installing the waterworks system was approximately $2,000,000.

The public buildings of Hamilton are in keeping with the progress of the city. The City Hall, built at a cost of $200,000, is located on James street north; the Court House, at corner of John and Main streets; the Post-Office, at corner of King and John streets, and the Public Library on Main street west. The Ontario Normal School, one of the finest educational institutions, is located at the corner of Hunter street and Victoria avenue.

Hamilton is essentially a manufacturing city. Probably in no other city of equal size in Canada is there to be seen such an application of skill and capital to widely diversified industrial operations. There are about three hundred manufacturing establishments, large and small, located within the limits of the city. Two of the most important are those of the International Harvester Company and the Canadian Westing-

Gore Park Extension, Hamilton.

house Company. A somewhat extended description of the works of the latter company will be found elsewhere in this number. The works of the International Harvester Company will, when completed, comprise 125 acres and employ 8,000 hands. The gray foundry building is 1,000 feet long and 85 feet wide, and there is a malleable foundry building of equal size. The foundry is equipped with electric cranes conveying three tons of molten metal at one time from the cupalo to large electric pouring cranes, which travel over the moulding floors and pour direct into the moulds. Electric cranes and automatic machinery reduce the amount of manual labor to the minimum.

POINTS OF INTEREST IN AND ABOUT HAMILTON, AND HOW TO REACH THEM.

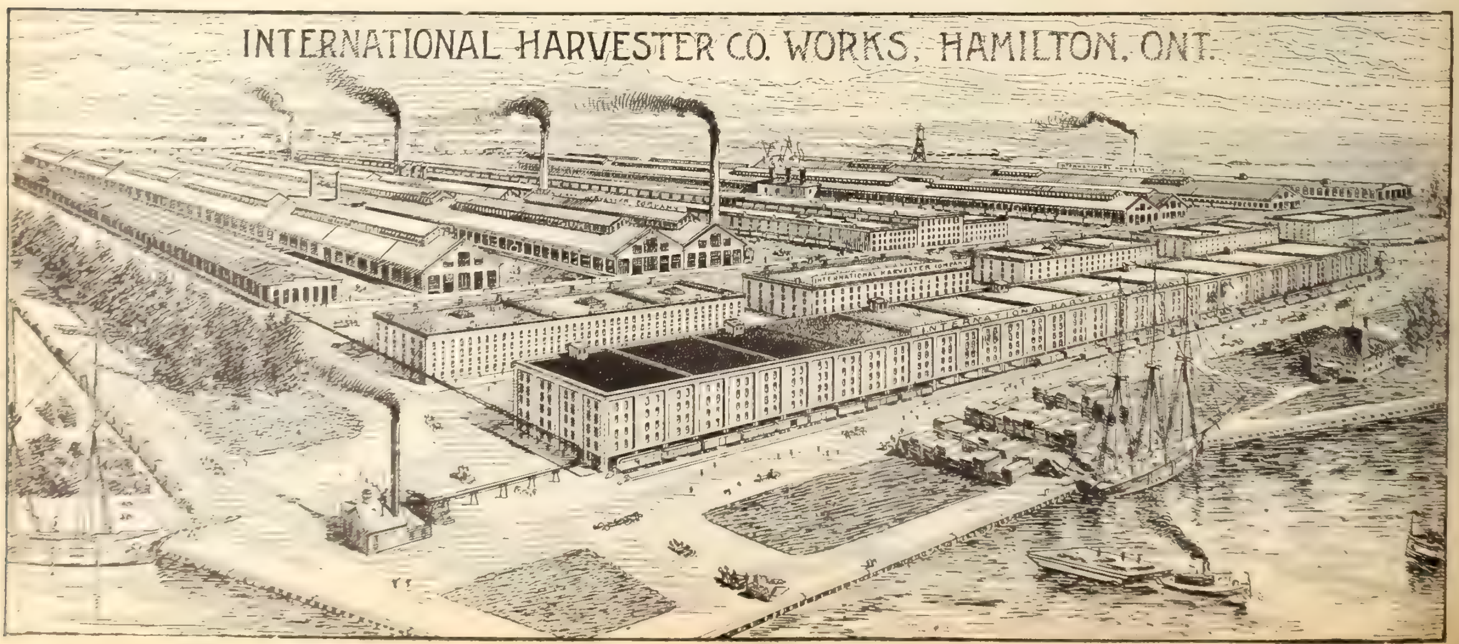
East End Incline R.R. to Mountain Top, take King street east and Wentworth street car.

City Hospital, Cataract Power Co.'s Transforming Station, Canada Screw Co., Sawyer-Massey Co., Hore & Sons' Wheel Works, Norton Manufacturing Co., Imperial Cotton Co., Stock Yards, Otis Elevator Co., Westinghouse Manufacturing Co., Sewage Disposal Works, Hamilton Jockey Club and Park, Sherman's Park and Summer Theatre, and many other points of interest, take Barton street car.

Hamilton & Barton Incline R.R. to Mountain Top, Insane Asylum and Cedoke Falls, take James street south car.

Irondale, International Harvester Co., Smelting Works and steel plant, Hotel Brant and the village of Burlington, take the Radial R.R., corner James and Gore Streets.

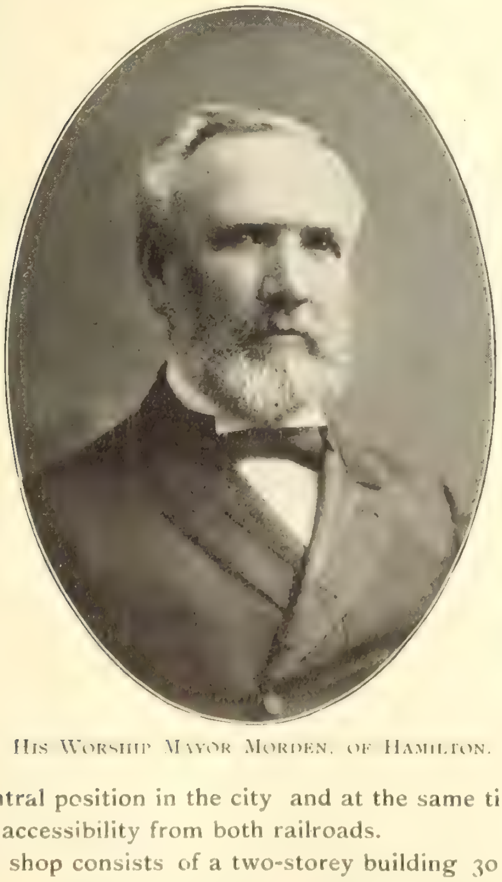
Stoney Creek and Battle Grounds, containing the Women's Wentworth Historical Society's Museum, Fruitland, Winona, Grimsby, Grimsby Park, Beamsville, take the H., G. & B. cars, corner Main and Catharine streets, which also pass the Hamilton Reservoir just outside the city.


INTERNATIONAL HARVESTER CO. WORKS, HAMILTON, ONT.

TORONTO AND HAMILTON ELECTRIC COMPANY.

The Toronto and Hamilton Electric Company have carried on business in the manufacture ot electrical machinery since the year 1895, when they purchased from the assignee the good will and plant of the insolvent Kay Electric Works, which was then doing business on James street north. Finding these premises too small and unsuited for the demands of their business, the firm was successful in securing possession of their present shop situate at 99-103 McNab street north, a loction which commends itself on account of its central position in the city and at the same time its ready accessibility from both railroads.

Mr. W. C. Hawkins,
Manager Hamilton Cataract Power, Light & Traction Company.



His Worship Mayor Morden, of Hamilton.

The shop consists of a two-storey building 30 x 120 feet, so situated that light is obtained on both sides, while the upper storey has the additional advantage of sky-lights. A large yard permits of ready access to the building for loading and unloading and gives facilities for storing of such material as can be left, more or less, exposed to the weather.

Electric motive power is used throughout the shop, while a 40 h.p. boiler in the boiler house to the rear affords a means of heating the shop and provides steam when required for testing purposes.

The machinery found in the building is of the latest type and improved patterns, including engine lathes, drills, planers, shapers, milling machines, boring mills, automatic notching and other power presses, circular and other shears. For the easy handling of heavy work the shop is equipped with geared travellers by means of which pieces of work may be readily lifted and transferred from one machine to another or from one part of the floor to another.

The winding department is equipped with the usual dipping vats for the insulation of the form wound coils and completed armature and ovens for the ready drying of the same under any desired safe temperature.

Mr. H. E. Job.

The firm is composed of Messrs. H. E. Job and Robert Lynch. The former is a graduate of the School of Practical Science, Toronto, and Mr. Lynch has had a thorough training in the mechanical side of the business.

The firm are prepared to supply a line of multipolar direct current machinery both of the belted type in sizes from 2½ k.w. to 50 k.w. and the smaller sizes of direct connected units. They are also getting out a multipolar motor of the wall and ceiling type, besides the old bipolar type which is still used where a small, cheaper machine is called for.

The Ontario Government has taken advantage of the Act passed in 1902 and appointed Hon. F. R. Latchford, Hon. R. Harcourt, and Hon. John Dryden as the Railway Committee of the Executive Council. Owing to the large number of electric railways that were being projected, it was felt when the act was passed, two years ago, that the many important questions frequently arising affecting municipalities should be referred to a regularly constituted body fer adjustment. Until recently, however, it was not found necessary to take advantage of the provision. The committee has jurisdiction over all railways, electric railways and street railways, subject to the Legislature, and may exercise the powers conferred on the Lieut.-Governor in Council and the Commissioner of Public Works by the Railway Act of Ontario or any special act, respecting railways. It is authorized to superintend agreements between railways for running rights, crossings, etc., and to settle disputes between railway companies and municipalities with respect to service, rates and speed of cars. It has the same powers as the High Court in regard to the summoning of witnesses, and may hold its sittings at any place in Ontario.

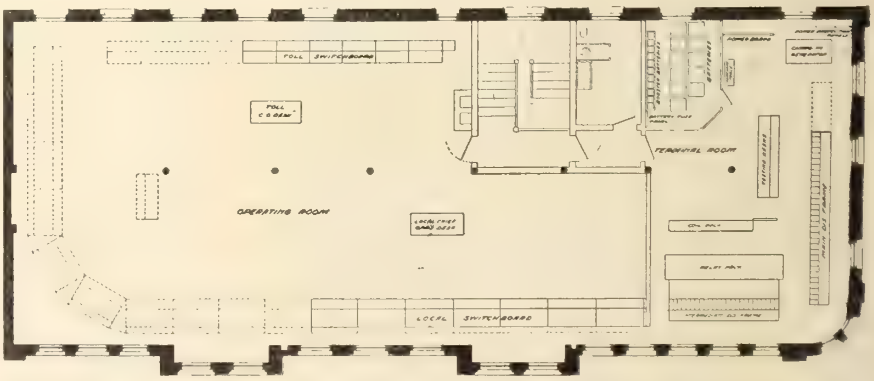
THE BELL TELEPHONE COMPANY, HAMILTON.

In the Bell Telephone Company's building at the corner of Hughson and Jackson Streets are not only the local office of the company, but the headquarters of the Ontario Department as well. This Department, under the management of Mr. Hugh C. Baker, comprises the territory between Kingston and Port Arthur, and is one of the largest and most important districts served by the company. There have been made and are still going on, many elaborate alterations to the interior of this building in order to install a new and modern switchboard. The building was erected in 1890-91, is of two stories in height, with a spacious basement. The lower portion is of stone; the upper of red pressed brick, the whole being of semi-fireproof construction. The basement is used for storage purposes, one room being set apart for a 12 h. p. gas engine and generator which is to be used for the charging of the storage batteries.

Bell Telephone Company's Building, Hamilton.

To the right of the entrance of the ground floor are situated the offices of the Ontario Department, while to the left are the public toll room, general offices of the Hamilton agency and the private office of the local manager, Mr. B. J. Throop. On this floor are also situated the locker and lunch rooms for the accommodation of the operators.

The first floor is the one which has been altered the most. The switchboard installed in 1891 is situated in the south-east corner. The cable terminals and distributing apparatus are located in the rear of the switchboard and were formerly separated from it by a solid partition. The operators' quarters were formerly in the north-west portion of the building. All the partitions on this flat have now been removed, and the whole of the first floor is one large room. A new common battery or relay switchboard is now being installed and will be in operation before the first of August.



Floor Plan of Bell Telephone Company's Hamilton Exchange.

The underground cable entrance, instead of being at the south end of the building as at present, has been removed to the north end, and the underground cables will be brought to the floor level in iron pipes and tile ducts built into the wall. The underground cables vary from two to four hundred pairs of paper insulated No. 22 gauge wires of the customary telephone pattern. At the floor level these cables are spliced to special cables whose wires are insulated with silk and cotton, and the whole core beeswaxed to prevent the entrance of moisture. The terminal cables are fanned out on a distributing frame having connecting clips on one side and the usual combination sneak current air gap protectors on the other. From this frame cables extend to a secondary and similar distributing rack known as the intermediate distributing frame, the function of which is to allow the signal and answering jack of any subscriber's line to be readily transferred from one panel to another of the switchboard, without disturbing the connecting or multiple portion of the subscribers' switchboard apparatus. Besides the intermediate frame is a relay rack for holding relays which control the subscribers' line signals, and next to it is the frame work which carries the repeating coils, one of which is used in every cord circuit of the switchboard. Close by is the wire chief's desk, which contains apparatus for testing both local and long distance lines; while the other side of the room is given up to the storage batteries' power switchboard and a motor generator for charging the batteries. The motor generator set is used as an alternative with the gas engine and generator in the basement, so that two separate and distinct sources of power are available, reducing the liability of the break down of the current supply to a minimum.

The switchboard extends from the end of the intermediate frame down the Hughson Street side of the room. The board is of the well known relay type having lamp line signals and two lamp supervisory signals. It is also provided with selective ringing keys so that any one of the subscribers on a four party line may be signalled without the others on the line being called.

The long distance board is situated on the west side of the room, communication between the two being effected by switching trunks which are equipped with lamp disconnect signals.

The switchboard is equipped for 2800 lines and has a capacity for 5600. About 1700 lines will be cut over on to the board, which will be cared for by about 17 operators, groups of lines of various numbers being placed before each operator according to the number of calls originated by the lines.

The floor of the operating room will be covered with cork to make the room as quiet as possible, while that of the power and distributing room is of white vitrified tile, being the cleanest and most easily kept floor, as well as, at the same time, presenting a very handsome appearance.

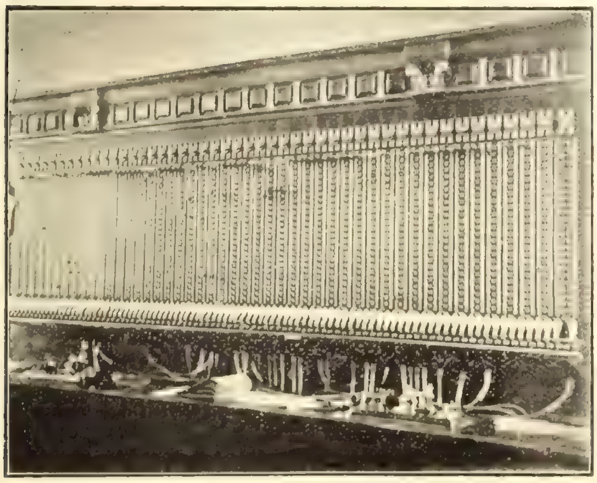
Everything about the rooms and apparatus is of the most modern type and very best construction, so that when completed Hamilton should have one of the most up-to-date and efficient telephone central offices on the Continent.

THE G. N. W. TELEGRAPH COMPANY, HAMILTON.

The main office of this company is located at 34 James street south. The former office at 20 James street south was destroyed by fire six years ago, necessitating a new office with a complete new outfit. The present office is all on the ground floor; the operating department is in the rear end, and all parts visible from the manager's desk. The wires enter at the front in two 50 and two 20 wire cables, pass through safety fuses before entering the switchboard, thence in cables under the floor to each instrument table. There are thirty sets of instruments, including five sets of automatic repeaters, in use.

Portion of Operating Room, G. N. W. Telegraph Company, Hamilton.

The new switchboard when installed six years ago appeared to have sufficient wire space for many years to come, but all blank spaces have been filled and a recent enlargement of twenty-four bars is nearly taken up.



Switchboard, G. N. W. Telegraph Company, Hamilton.

No less than twenty-seven new wires have been put up in the last six years, consisting of nine circuits extending from Toronto to Buffalo, three from Hamilton to Buffalo, two from London to Buffalo, and one from London to Toronto.

In 1858 there were only three commercial circuits and one railway circuit, or eight wires in the office; now the switchboard contains eighty-three active wires—only two of which are railway wires—besides seven brokers' loops, and seventeen call lines not on the switch.

The general manager is Mr. Geo. Black.

THE ELECTRICAL SUPERVISION SOCIETY.

We note with interest the advent of the Electrical Supervision Society in the field of consulting electrical engineering. This organization looks forward with confidence to a most successful career, having obtained the services of Mr. K. L. Aitken, whose engineering ability is recognized by all those with whom he has come in contact. Mr. Aitken is a Canadian by birth, but has been educated and brought up in the States. Since the time when he entered engineering work, some seven years ago, he has had enviable opportunities for practical experience, having been employed by the following concerns: Westinghouse, Church, Kerr & Co., New York City; The Sprague Electric Co., Bloomfield, N.J.; The Westinghouse Electric & Manufacturing Co., Pittsburg, Pa.; The Westinghouse Machine Co., Pittsburg, Pa., and The Canadian General Electric Co., Toronto. He has held a position with this company during the last year and a half, and has given this up to enter consulting work.

On the tenth of this month Mr. Aitken delivered an illustrated lecture on "The Toronto and Niagara Power Development," before the Toronto Branch of the American Institute of Electrical Engineers, and as it is the intention of the Canadian Electrical Association to visit Niagara on the last day of the Hamilton meeting, for the purpose of inspecting these works, Mr. Aitken has consented to abstract his paper on the first evening of the convention and to show the lantern slides previously used, so that the members of the Association will have a clear conception of the Niagara proposition before they make the trip to the Falls.

Mr. George Black,
Manager G. N. W. Telegraph Company, Hamilton.

ENLARGEMENTS NECESSARY.

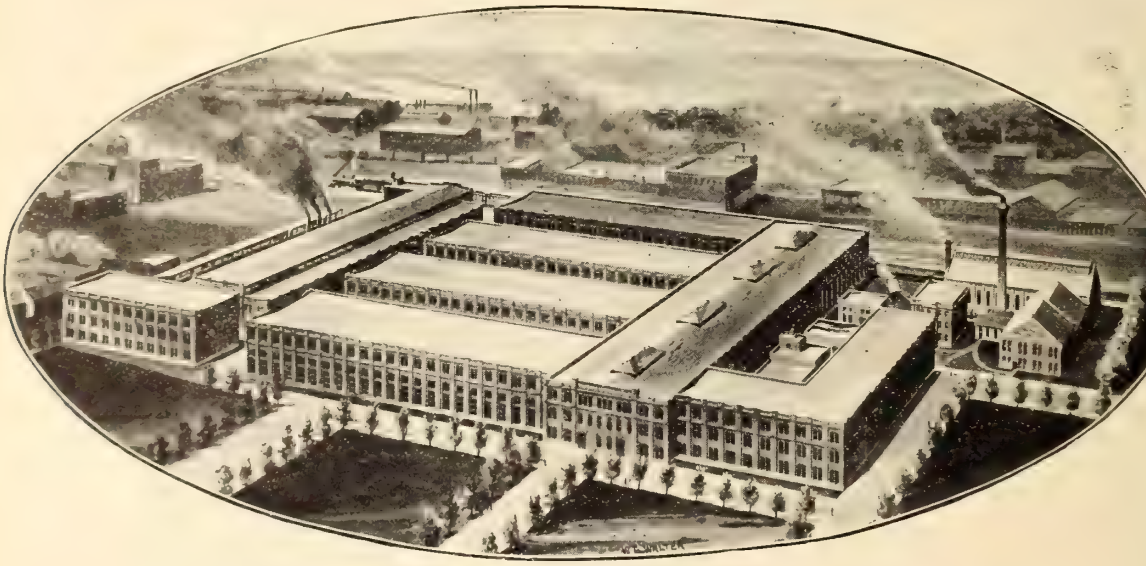
Mr. R. B. Hamilton, managing director of the Packard Electric Company, of St. Catharines, reports business as particularly brisk in all lines and that the entire plant has just been under the remodelling process to provide enlargements for their lamp, transformer and meter departments. Additional equipment is being placed in all departments. Orders are coming in with great rapidity and one order recently received by the company was for 1500 Type "G" recording watt meters. This order is probably the largest single order ever received by any Canadian electric company at one time. Delivery on this order does not extend over any long period, but all of the 1500 meters must be delivered before November 1st of this year.

THE CANADIAN WESTINGHOUSE COMPANY.

The advancement of Canada as a commercial nation has been remarkable during the past few years. The new impetus has been felt in development of water powers, in mining, agriculture, transportation and marufacture, and the increment of each has reacted to swell the contribution of the others until at present Canada finds herself on a rising tide of prosperity, all the more marked in comparison with the hesitancy and stagnation apparent in many other portions of the business world.

Among the various fields of activity, that of manufacturing has more than held its own. Not only have resident Canadians been alive to the opportunities of the period, but also individuals and corporations of other countries have been led to establish manufactories within the country, to aid in supplying the growing consumption of their products.

A highly interesting installation of the latter sort is the new plant under construction at Hamilton for the manufacture of the well known types of the Westinghouse Electric and Manufacturing Company. From the time when electrical apparatus was first made use of in Canada, the Westinghouse Electric and Manufacturing Company of Pittsburg has furnished a large and increasing portion of this apparatus in the Dominion, until time arrived, when, in justice to their customers, it was found advisable to establish a distinctively Canadian factory to secure that intimacy of relation which is so advantageous alike to the manufacturer and client.



WORKS OF THE CANADIAN WESTINGHOUSE COMPANY, HAMILTON.

Passing in review the various sites suitable for the location of such a factory, it was natural that the choice should fall on Hamilton, not alone from the natural advantages of that city from the standpoint of a manufacturer, but, as well from the fact that for a term of eight years another Westinghouse interest, the Westinghouse Manufacturing Company, Limited, had been located in that centre, engaged in the manufacture of the Westinghouse air brakes for the equipment of Canadian rolling stock.

To join under one management the existing air brake business and the electric business to be instituted, a new organization was formed under the name of the Canadian Westinghouse Company, Limited; and, leaving the air brake factory in its present state of efficient euipment, work was at once started to provide a plant of modern excellence and completeness for the manufacture of electrical apparatus. Notwithstanding an unusually severe winter, construction work has been pressed throughout, until at present writing it is safe to say that an operative condition of the plant will be reached this Fall.

The Canadian Company will operate under the enjoyment of an agreement with the Pittsburg Companies, by which all designs and processes of the older companies will be at its disposal, and thus fortified with the results of years of successful experience, equipped with a plant than which no better can be found, and aided by the co-operation of many of Canada's most representative citizens, an assured future stands before the company, and the Canadian user is assured of the best obtainable apparatus.

The lines of manufacture to be taken up comprise alternating and direct current generators; alternating and direct current motors, including railway motors; controllers; transformers; switchboards and switches; rheostats; instruments; meters; arc lamps, and the various subsidiary apparatus included in the general line of Westinghouse equipment.

The new buildings provided consist of foundry, pattern shop, pattern storage, general machine shop, detail machine shop, warehouse, insulation treating building, boiler house and transformer building. On the diagram of the property shown in the illustration, these are lettered from "A" to "I" inclusive, in the order just recited, "L" is the brake plant and "K" the office building, enlarged to accommodate the increased force of the new company.

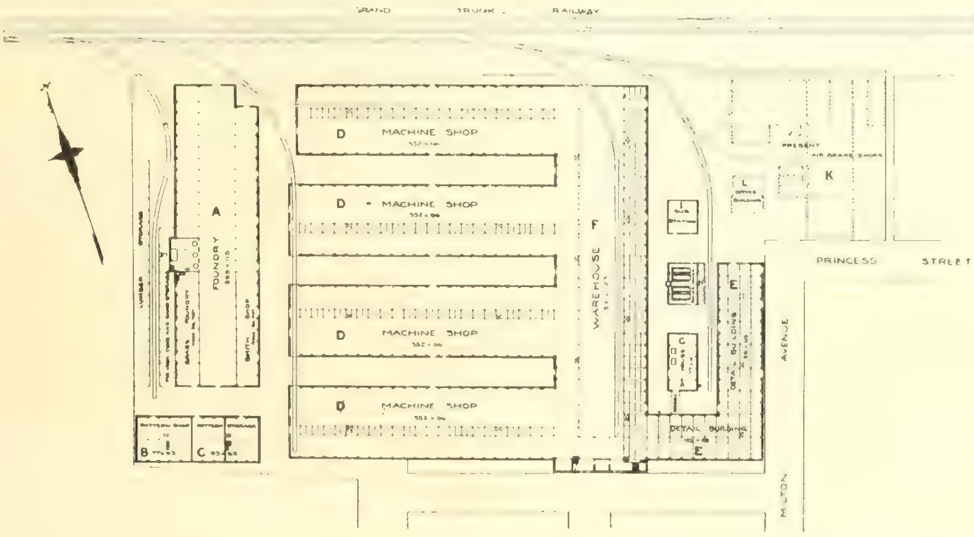
In laying out the manufacturing buildings on the property two cardinal points were kept in view — the first, that progress of material from raw to completed state should, as far as possible, be in a continuous direction, and the second, that the plan adopted should lend itself to an initial installation which would constitute a complete unit, and also be capable of reproduction along its own lines to an extent limited only by the total available property. On the latter point it may be said that something less than half of the total installation shown in the illustration is at present under construction, the northern half of foundry and warehouse, along with corresponding machine shop wings, being left for future extensions. Regarding progress of material through the plant, it may be pointed out that with raw material received on track west of the foundry, progress is in general from this point to the warehouse, from which all shipments are to be made over tracks conveniently located within the building for this purpose.

The foundry is of monitor roof construction, with middle and two side bays. In the west bay are located the cupola house, the core room and the brass floor, while just outside along the west wall are located the bins for pig, sand, limestone, etc. A portion of the east bay is separated by partition from the foundry space to serve as blacksmith shop. The main bay is served by a 20 ton crane, the length of the building being also traversed by travelling jib cranes, operating at a lower level. A mezzanine floor over a portion of the core room provides suitable toilet facilities without reducing productive floor space. An electrically driven elevator is provided to deliver iron from yard to charging floor, and a coke conveyor, also electrically driven, receives coke from railroad car and deposits it in an appropriate bin on the charging floor.

The pattern shop, located conveniently near the foundry, is three stories in height, beside a basement to accommodate shafting for machinery located on first floor. The first floor is devoted to carpenter and cabinet shop uses, while the second and third floors are for pattern making. An electric elevator serves this building from basement to top floor. The pattern storage building, adjoining, is similar in construction, except the basement, which is unnecessary.

The general machine shop is arranged with a high bay covered by 20-ton crane and low bay with 5-ton crane. In the former the heavier machine tools are located and it is here that mainly the stationary parts of generators and motors will be finished, while the low bay will be devoted to preparation of the rotary parts, and the gallery floor above the latter will provide space for the manufacture of commutators, brushholders, bearings, etc., also for tool room and controller department. Toilet rooms and heating and ventilating fans are placed on a narrow mezzanine floor between the high and low bays, the same being reached by stairways from both the ground and gallery floors. The elevators also pass up through this floor and industrial tracks run under the mezzanine, along by the foot of the elevators on the ground floor. After the completed rotary part has received its winding at the eastern end of the low bay it is passed by jib crane under the mezzanine floor at this point on to the eastern end of the high bay, where it is placed in its corresponding stationary part, which has been under construction in this aisle, and the auxiliary parts are received at the same point by elevator from the gallery floor. In addition to the crane serving the main portion of the high bay, this eastern end or assembling floor is provided with an additional crane of like span, but at a lower level, so that by it machines can be delivered from the assembling floor, through under west gallery of warehouse into middle bay of the latter building, where the north and south crane can pick up the load for further handling.

The warehouse has a high bay in the middle, with one gallery on the west side and two galleries on the east side. The machines delivered, as just described, from the general machine shop, are passed to the testing floor on the west side of the main bay and after test are finished, painted and shipped on cars from the warehouse track. This track also is the means for entry into the plant of the less bulky material and supplies, which are stored in this building for ready distribution to both the general and the detail machine shops. The floor east of the tracks is at car floor level to facilitate handling of such material, and elevators are of course provided for distributing to the various floors.



PLAN OF GROUND FLOOR, CANADIAN WESTINGHOUSE COMPANY'S WORKS, HAMILTON.

The detail machine shop has two floors throughout, beside the ground floor at levels, corresponding to the two galleries on the east side of warehouse, with which they directly communicate. It should also be noticed that the top floor of this building is at the same height as the gallery in the general machine shop and the west side of warehouse, and that a connecting gallery at the same height is carried around the south end of warehouse building. On the ground floor of the detail machine shop the coil winding and insulating departments are located, this being convenient both for receipt of wire from warehouse and delivery of completed coils to winding and assembling spaces at east end of general machine shop already referred to. The second floor is devoted to the machine work necessary on switches, rheostats, meters, instruments, arc lamps, etc., and on the third floor are the assembling and testing rooms for these lines of apparatus. No cranes are needed in this building but elevators are provided, securing easy access to various floors.

The insulating-treating building is separate from the main group, so that this work, involving use of inflammable materials, can be isolated. Convenient communication with the detail building is provided by a two story enclosed bridge cut off at each end by fire doors.

The boiler house, it will be noted, is small in comparison with the main plant, which is due to the fact that the use of steam will be largely restricted to heating and drying purposes. Most of the steam for drying will be used in the insulation-treating building next adjoining, but for heating the buildings it will be piped to nests of coils suitably installed in each building, with fans to distribute the air heated by these coils.

Power for manufacturing and testing purposes, as well as for lighting, is to be obtained from the Cataract Power, Light and Traction Company. Current will be received in the transformer house at 2,400 volts, and distributed at 440 volts for general shop purposes, although lighting distribution will be at 110 volts, and transformation to direct current will be made to supply some of the cranes and machine tools.

The construction of the buildings, which is in the hands of Westinghouse, Church, Kerr and Company, of New York, as engineers and general contractors, is of the most modern approved type. The foundations and walls up to window sill line are of concrete, above which the walls are of brick, laid up in cement mortar. Floors and roofs are of reinforced concrete throughout, and in detail machine shop and pattern buildings even the columns are of this construction. The result is a group of buildings as desirable and as nearly fireproof as it is possible to make them. All roofs are practically flat, with drainage so arranged that the leaders are carried down through the interior of the buildings to avoid stoppage by freezing in cold weather. Floors are top dressed with 1 inch maple and roofs with tar and gravel.

Transportation between the foundry and all buildings, including the air brake plant, will be by industrial railway, operated by storage battery locomotive. The standard gauge tracks on the property are directly connected with main line of the Grand Trunk Railway for receipt of material and shipment of product. The main entrance to the plant, for employees, is at the south end of warehouse building, a central point at which will be located time checking devices, and from which stairways lead directly to the various floors. Entrances for teams from the city streets are provided near west end of machine shop and in front of the office building.

The equipment of the plant will be on the most modern approved lines, as developed by experience of the Pittsburg factories.

The directors of the company are :---George Westinghouse, H. H. Westinghouse, George C. Smith, L. A. Osborne, W. Y. Soper, C. F. Sise, Frank H. Taylor, Thomas Ahearn, Paul J. Myler, Hon. J. M. Gibson.

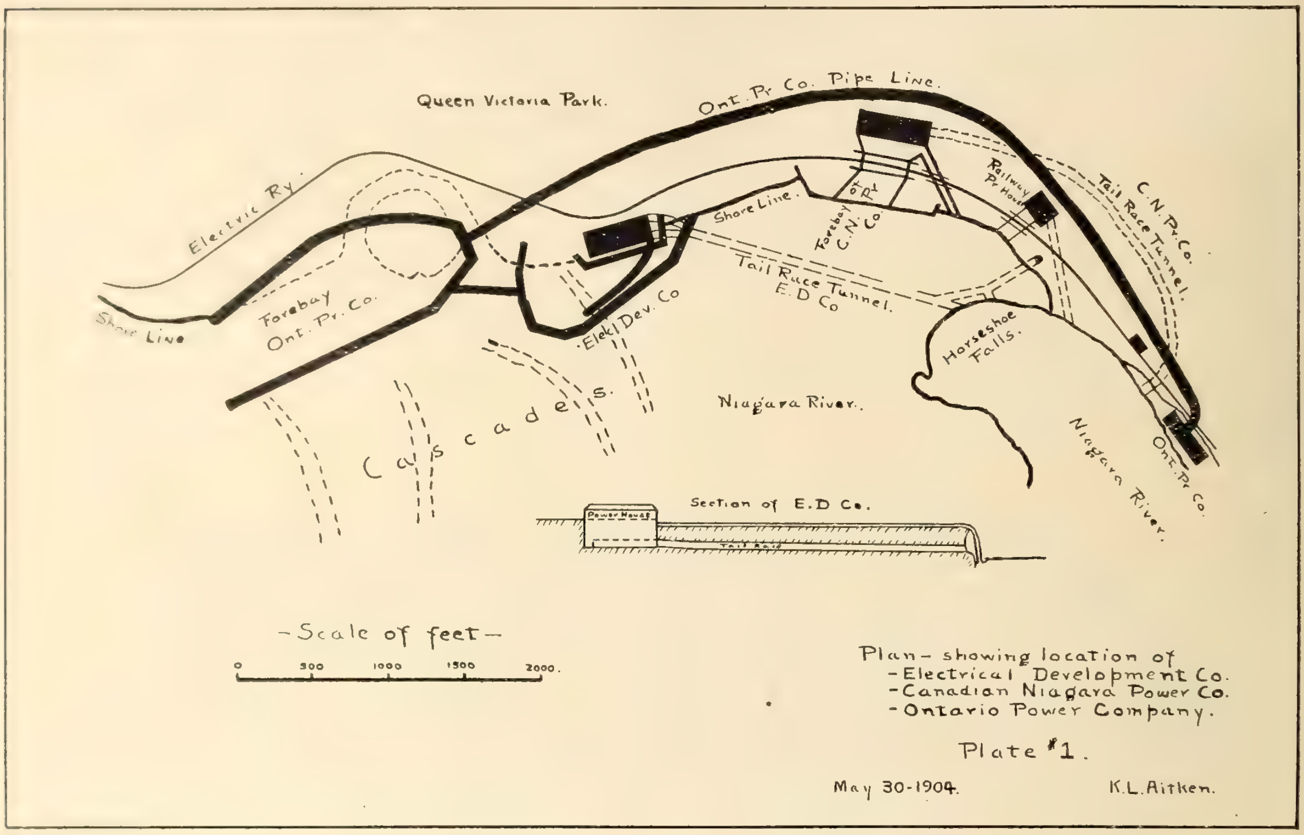
The officers are :---President, George Westinghouse ; Vice-Presidents, H. H. Westinghouse and Frank H. Taylor ; General Manager and Treasurer, Paul J. Myler ; Secretary, John H. Kerr ; sales manager, N. S. Braden ; superintendent air brake department, Percy Domville; superintendent electric department, F. A. Merrick.

The head office of the company is at Hamilton, and district offices have been established at Montreal, Toronto, Halifax, Vancouver and Winnipeg.

POWER DEVELOPMENT WORKS AT NIAGARA FALLS, ONT.

THE ONTARIO POWER COMPANY.

The accompanying illustrations will assist to an understanding of the progress that has been made by the Ontario Power Company. The excavation of rock, which constituted the major portion of the work in connection with the 200,000 horse power intake from the Niagara river above the Dufferin Islands, is nearing completion. The retaining walls, of concrete, to bound the forebay, are also nearly finished, and construction of buildings to house the screen and gate mechanisms is about to commence and will be completed during the summer season. Half of the 6,600 feet of main feeder pipe, which is 18 feet in diameter, has been installed in the trench previously excavated through the Queen Victoria Niagara Falls Park. Tunnels for four penstocks of 40,000 h.p. are completed, and construction of penstocks is well under way.



Plan – showing location of
- Electrical Development Co.
- Canadian Niagara Power Co.
- Ontario Power Company.

Plate #1.

May 30-1904. K.L.Aitken.

ONTARIO POWER COMPANY—INSIDE 18 INCH PIPE; SIX FOOT MAN IN FOREGROUND.

ONTARIO POWER COMPANY—LAND WALL INNER FOREBAY FROM SCREEN HOUSE SITE.

The work on the generating station is progressing rapidly. The shortness of the period in which work can be carried on at this point, adjacent to the foot of the Horseshoe Falls, requires that construction proceed with the utmost dispatch. It is therefore expected that this portion of the work will be completed before ice and winter conditions set in.

Other features and the details incident to the above have all been engineered by Messrs Nunn, the company's engineers, and the completion of the first instalaltion is only a matter of a comparatively short time.

THE CANADIAN NIAGARA POWER COMPANY.

This company is now constructing works in the Queen Victoria Niagara Falls Park above the Horseshoe Falls, designed for a capacity of 110,000 horse power. The general design is similar to that of power house No. 2 of the Niagara Falls Power Company, now in operation on the United States side of the river.

The tunnel tail-race, which is just completed, is 2,200 feet long and of a horseshoe form, 25 feet high and 19 feet wide, being lined with 17 inches of concrete with vitrified brick facing. The grade of this tunnel is 7 feet per thousand, which will give a speed of water when plant is in full operation of about 27 feet per second.

The head canal has a clear waterway 15 feet deep and 250 feet wide, and is crossed by a 5 span stone arch bridge which carries the tracks of the Niagara Falls Park and River Railway, a carriage way and sidewalk. This canal widens into a forebay 600 feet wide, extending the whole length of the power house.

Protection from ice is afforded by (a) an outer ice rack along river face ; (b) line of submerged arches forming outer wall of forebay room ; (c) a fine ice rack extending the whole length of power house inside the forebay room and immediately outside the penstock mouthpieces ; (d) overflow weir which can be used in combination with floating beams to draw floating materials back into the river again by means of sluiceway channel.

Ontario Power Company—West Side Pipe Trench North from Station.

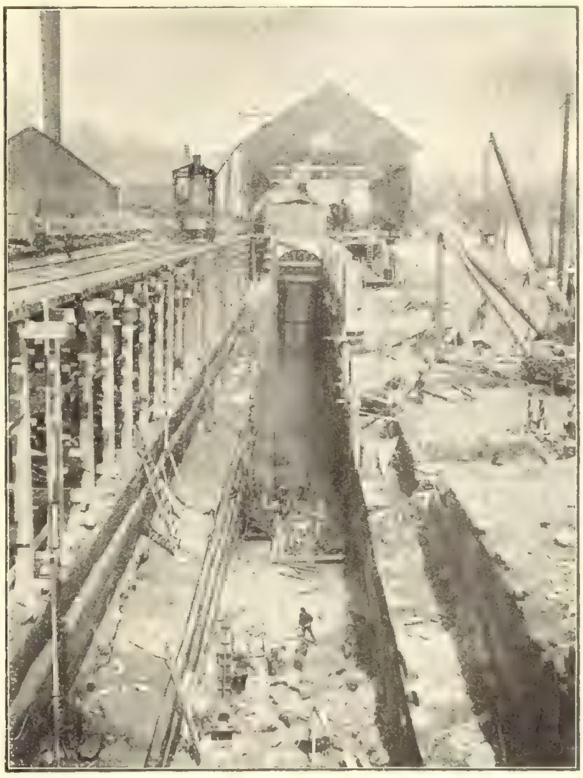
The wheel pit is 165 feet deep, 18 feet wide inside of brick lining and 570 feet long.

The turbines, each of a capacity of 12,500 horse power, were designed by Messrs. Escher, Wyss & Company, of Zurich, Switzerland, and are of the twin Francis vertical type, inward discharge, two draft tubes to each unit discharging into the open tail race below. Three of these units are being manufactured and installed by this firm and two units of the same design by I. P. Morris Company, Philadelphia.

The generators, each of 10,000 horse power, are of the internal revolving field type, and will generate alternating three - phase current, 25 cycles, at 12,000 volts. Five of these are being installed by the General Electric Company. The generator and turbine are direct connected by a vertical shaft and will revolve at 250 r.p.m.

The auxiliary machinery, consisting of exciter turbines, exciters, water pumps, oil pumps and oil tanks, etc., are located in three chambers built into the side of the wheel pit 100 feet beneath the surface. This machinery will all be operated by an independent water service drawn from the canal above.

The power house building, for five units, is being constructed of Queenston limestone roofed with tile and has installed two 50(—)ton electric cranes for service in installation of machinery. The power house will be lined inside with mottled buff brick, enamel brick and marble.



Canadian Niagara Power Company General View of Wheel Pit Looking from Extreme South.

Underground conduits are being constructed from the power house to Upper Arch bridge, with a capacity of 75,000 horse power, and from power house to a transformer station situated south and outside of Queen Victoria Park for a capacity of 50,000 horse power.

Canadian Niagara Power Company—Showing Progress on Excavation of Forebay; Steel Work for Power House on Left and Stone Bridge on Right.

A transformer house, equipped with water cooled transformers, has been constructed of a present capacity of 25,000 horse power. It will be supplied with water for cooling purposes from pumps located in chambers of wheel pit. There will also be a stand pipe carrying one day's supply of water to be drawn upon in case of any accident to this pumping system.

THE ELECTRIC DEVELOPMENT COMPANY.

In the February number of the ELECTRICAL NEWS there appeared drawings, photographs and particulars showing the progress made in the development of electric power at Niagara Falls by the Electrical Development Company of Ontario. The water is conducted through steel tubes to turbines located in the bottom of a wheel pit constructed through solid rock and provided with masonry lining. The plans call for eleven generating units of 12,500 horse power each, revolving at 250 revolutions per minute. The hydraulic work has been carried on with great dispatch, and the construction of the power house is about to be commenced. This building will be 500x70 feet wide, with an elevation about 40 feet in height.

The transmission line from the power house to Toronto will be built by the Toronto and Niagara Power Company, the distance being about 80 miles.

The resident engineer for this development is Mr. Beverley R. Value.

A by-law to provide $10,000 for electric light and waterworks improvements was defeated at Strathroy, Ont., last month.

Mr. J. A. McCrossan has been appointed electrical engineer for the city of Vancouver, B.C.

Mr. A. R. Doble, private secretary to the general manager of the Bank of Montreal, and secretary of the Mexican Light, Heat and Power Company, returned recently from the city of Mexico. He reports that rapid progress has been made in carrying to completion the power development works of the above named company.

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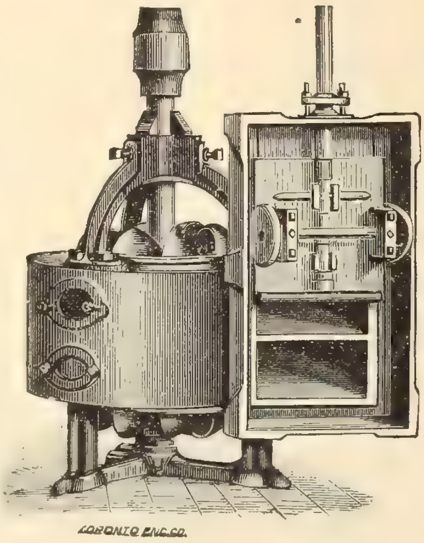
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SPARKS.

The Warren Electric Company are about to install a system of street lighting in the town of Blenheim, Ont.

The Sarnia Street Railway Company, Sarnia, Ont., have decided to extend their road to Wees Beach this summer.

The Dominion Government has just taken tenders on the supply of power and telephone sub-marine cables for the Welland Canal.

The municipality of Kildonan has granted a franchise for thirty-five years to a company which proposes to build an electric railway from Winnipeg northward through the municipality

The Goldie & McCulloch Company, of Galt, Ont., have issued a booklet descriptive of the engines installed by them for the Cataract Power, Light & Traction Company at Hamilton. Electrical and steam engineers may have a copy for the asking.

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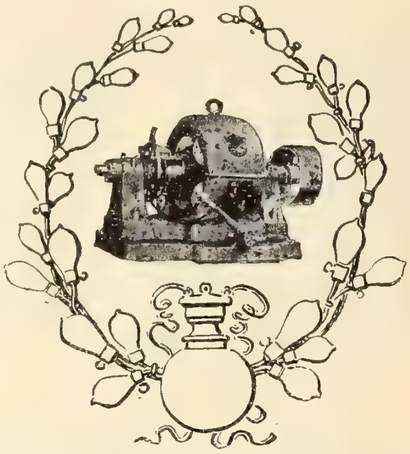

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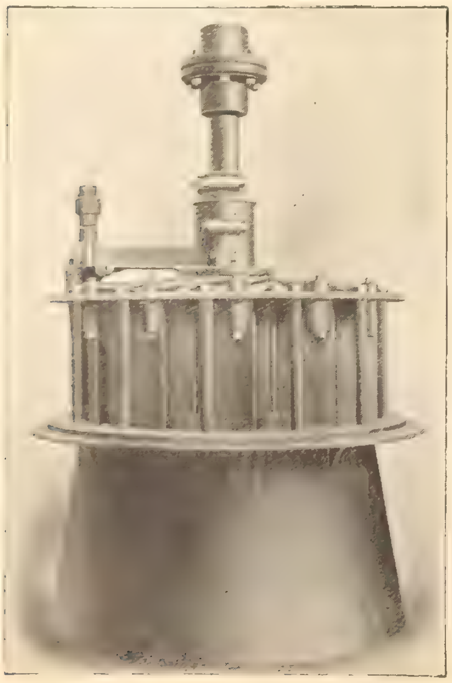

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SPARKS.

The capital stock of the London Street Railway Company, London, Ont., has been increased to $500,000.

Mr. D. W. Ackerman some time ago purchased from the Georgian Bay Lumber Company the water power at the mouth of the Severn river. He is now negotiating for and expects to get a contract for lighting the town of Midland, Ont., when he will commence the work of development.

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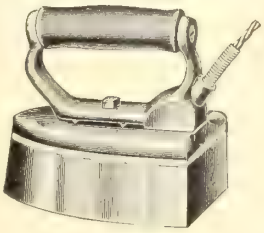

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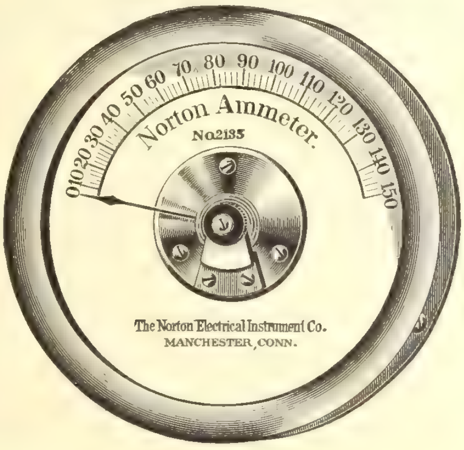
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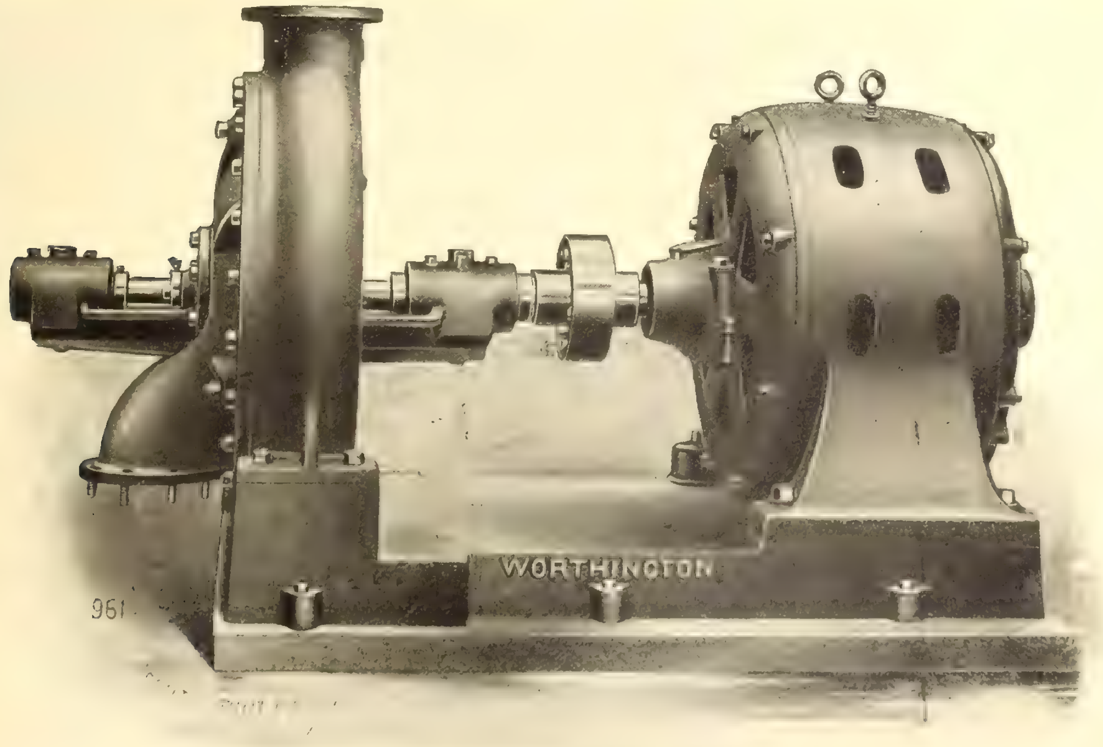

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SPARKS.

The village of East Toronto, Ont., is about to install a waterworks system, and it is probable that the pumping will be done by electric power. The chief engineer for the work is Mr. John Galt, C. E., of Toronto.

At the annual meeting of the St. Martin's Telephone Company, held at St. John, N.B., May 11th, the election of officers took place as follows: C. M. Bostwick, president; C. D. Trueman, vice-president; A. W. McMackin, secretary; W. H. Skillen, W. H. Jarvis, and A. A. Stockton, directors.

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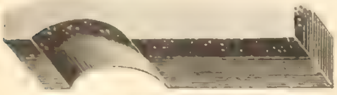

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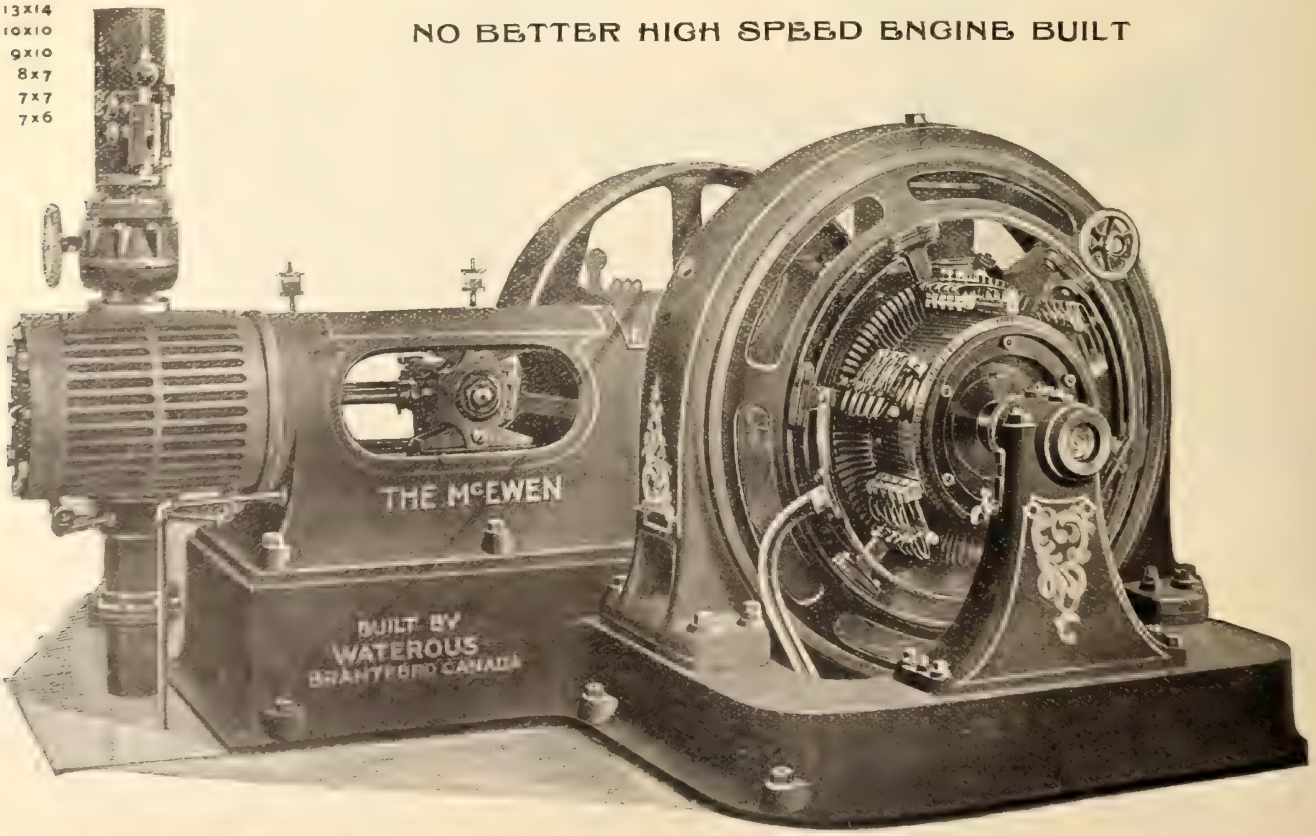

WATEROUS, BRANTFORD, CANADA

SPARKS.

The bill to incorporate the Lievre & Ottawa Railway Company was defeated by the Railway Committee of the Dominion Parliament. The company intended building an electric railway from Ottawa to Buckingham, with power to extend north to the proposed Grand Trunk Pacific line.

The Montreal Street Railway Company have under construction fifty new semi-convertible cars that can be used either in winter or summer. They cost about $6,000 each, and are to be equipped with the latest improvements, including air brakes, etc. Instead of long cone-covered benches on each side of the car, a separate chair seat is provided for each passenger.

The Thorold and Lake Erie Railway Company, recently incorporated, propose to construct an electric railway from Thorold to Port Colborne and Fort Erie, with a branch from Port Colborne through Dunnville and Cayuga to Brantford. The incorporators of the company include Messrs. J. W. Norcross and John McCullough, of Port Colborne, and George T. Smith and J. E. Taschereau, of Quebec.

The City Council of Preston, Ont., purpose submitting a by-law to the ratepayers to raise $25,000 to purchase the electric plants in Blair and remove them to Preston. There are two separate plants in Blair, Mr. John Scherer owning the commercial plant, and Mr. Fenwick the street lighting plant. These gentlemen have agreed to accept $12,000 and $11,000 for their plants respectively. The extra $2,000 would be required for improvements.

At a conference of a committee of the City Council of Peterboro, Ont., and representatives of the Canadian Machine Telephpne Company, held on May 17th, a draft agreement was made granting a ten years' franchise for a telephone system to the company on the conditions following: Wires to be placed underground in the business quarters of the town; the price of telephones to be for residences $15 per year, business telephones $20, residences and business telephones to one person $30; lines to be completed and system in operation within one year.

The Stratford-St. Joseph Electric Railway Company have elected the following officers: President, T. G. Coursolles; vice-president, N. M. Canton; secretary, O. Bissonnette; treasurer, Thomas Tombyll. The right of way has been purchased from St. Joseph to Hensall, and Mr. F. H. Hamel, C.E., is going over the ground fixing the levels for the grading. The preliminary plans call for a line from St. Joseph, through the village of Zurich to Hensall, ten and a quarter miles; thence to Chizelhurst, four miles; thence to Fullarton, passing midway between Cromarty and Staffa, twelve miles; thence through Carlingford to Avonton, and, following the Avon river, into Stratford, a distance of 38 miles.

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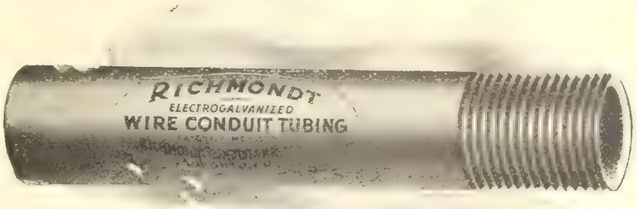

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A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates:

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American Circular Loom Company's
AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED
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The ORIGINAL and only GENUINE "Circular Loom." Has been in the market for twelve years, and handled by us for over nine years. No other substitute has ever taken its place for quality and adaptability. For price lists, discounts and full information, address

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Instant shipment made. Large stock of all sizes always on hand.

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—Manufacturers of the
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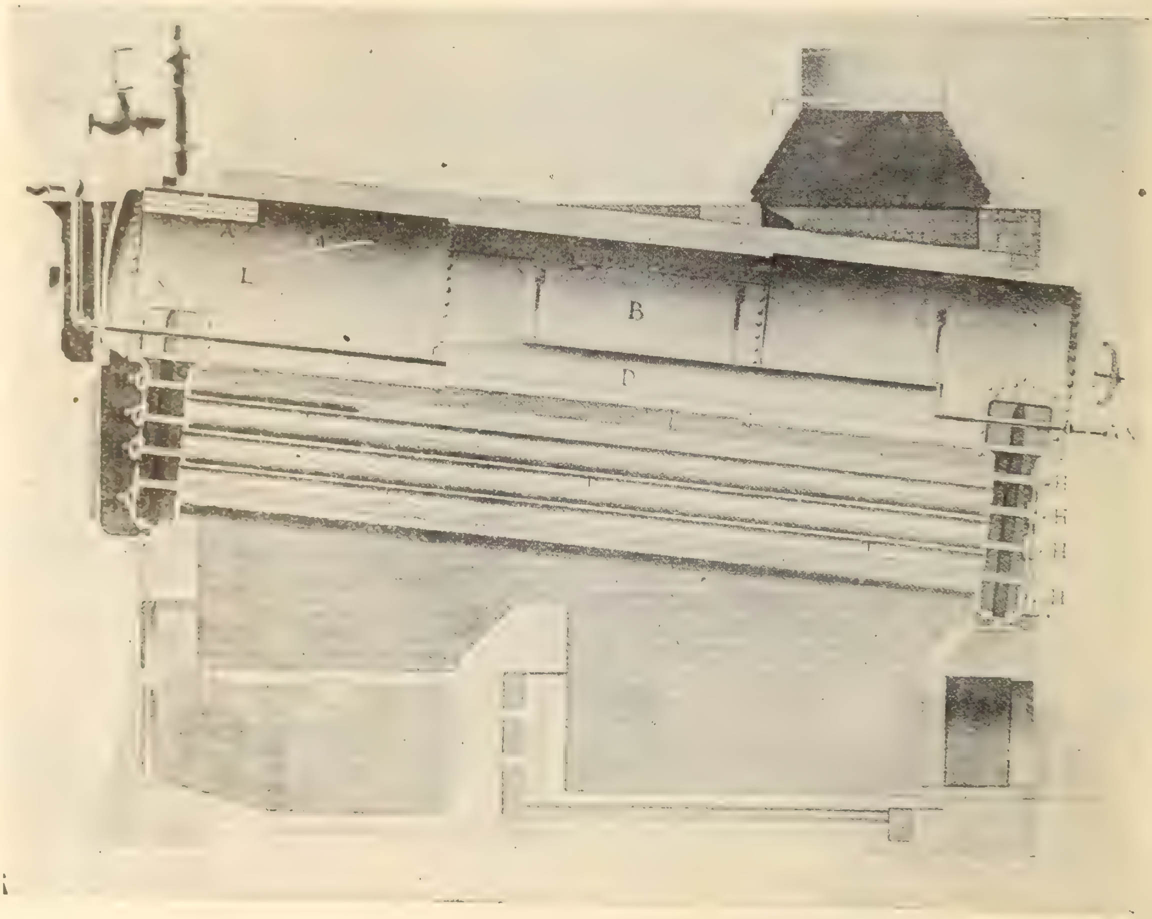
Reduce your fuel bills 25% by replacing your old Tubular Boilers with the **HEINE SAFETY WATER TUBE BOILERS.** Unexcelled by anything in the market for Economy, Efficiency, Safety, Durability.



Fitted With McClave Shaking Grates or for Underfeed Stokers.

At a recent test conducted by the Chief Engineer of the Boiler Inspection & Insurance Co. of Canada at the Works of the Toronto Carpet Manufacturing Co. between two large tubular boilers and one "Heine", the saving of coal was 28% in favor of the Heine Boiler. This test was made while doing the ordinary work of the factory and the firing was done by the Company's own men and entirely independent of the Heine Co.

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Direct Current.
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Single and Polyphase. Squirrel cage rotor. Up to 5 h. p.

We are not afraid of competition, either as regards quality of machines, prices or deliveries.

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Single and Polyphase. Handwound rotor, with slip rings. From 3 h.p.—50 h.p.

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Single Phase only. Special. Suitable for starting with heavy starting torque. Small current consumption.

From 1 h.p.—30 h.p.

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Telegraphic Address : Rhodique, London
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SPARKS.

The City Council of Peterboro, Ont., have granted the promoters of the street railway an extension of time to September 1st for having the road in operation. It was found necessary to purchase new cars and motors, which cannot be delivered until the middle of August.

The Western Electric Light & Power Company has been incorporated at Brandon, Man., to develop a water power and supply electric light and power. The capital stock is $300,000, the promotors including Mr. John Russell, barrister, of Winnipeg, and Mr. W. M. Alexander, miller, of Brandon.

The FIRSTBROOK BOX CO., Limited
King St. East, - TORONTO
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TOPPINS,
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Send for our new Telephone Catalogue.

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P. O. Box 448 - *HALIFAX, N. S.*

SPARKS.

Telfer, Telfer & Company, electricians, Montreal, have dissolved.

The Canadian Economic Lubricating Company, Montreal, has been incorporated, with a capital of $50,000, to manufacture lubricating and other oils. The directors include Messrs. W. B. Converse, J. Marsden and O. C. Pangman.

It is understood that Mr. T. Mitchell, of Forest, Ont., has secured permission from the Ontario Government to dam the Sauble river at Rock Glen, and that he intends developing the water power and supplying electric light and power to the village of Forest.

Mr. R. A. Ross, E. E., Montreal, has been engaged by the city of Kingston, Ont., to submit a report on the necessary improvements to the electric light plant recently acquired from the Kingston Light, Heat & Power Company. It is proposed that the plant shall supply power to the street railway.

Mr. John McGowan, of Sydney, N.S., has invented a new railway crossing gate, which works by means of a third rail annexed and parallel to the ordinary rails and raised above them sufficiently high for the wheels of the engine to lower it down to the level of the ordinary rail. Simultaneously with this, the gate is lowered and remains down until the third rail is relieved, when the gate springs back into its place.

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responsibility resting upon our manufacturers and power users in Canada is that in connection with their Steam Plants. The Boiler Room is the place where precaution is taken.
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ENGINEERS who follow the constant development in Circuit Breaker practice will remember that there is not on the market to-day a single important type of Circuit Breaker which did not originate with the Cutter Co. We are specialists in this line and would be glad to give information and quote prices.

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Circuit Breaker Engineers and Sole Agents for
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OLAF E. GRANBERG,
Chief Inspector, P. Q.
Board of Trade Bldg., Montreal.
CHAS. O. GRANBERG, Inspector, "
A. GEORGES CHAMPAGNE, " "
A. M. BONNYMAN, Amherst, N. S.

H. N. ROBERTS, Secretary-Treasurer.

WESTINGHOUSE STEAM TURBINES.

The Canadian Westinghouse Company, Limited, of Hamilton, Canada, have sold to the Northern Electric & Manufacturing Company, Limited, of Montreal, Que., who are large manufacturers of telephone apparatus, a 300 K.W. steam turbine unit, consisting of a Westinghouse-Parsons turbine and a Westinghouse turbo-alternator. They report numerous inquiries for these units, and anticipate a brisk demand for them in Canadian territory.

TRADE NOTES.

A very complete catalogue descriptive of the modern pumping machinery manufactured by Fairbanks, Morse & Co., of Chicago, has lately been received.

The International Boiler Compound Company, of Chicago, whose advertisement will be found in this paper, advise us that their business is rapidly developing, they having recently filled orders for several carloads of their material.

"The Smallest Size of the Greatest Lamp on Earth" is the description accompanying a miniature incandescent lamp which the Sunbeam Lamp Co. are sending out to their present and prospective customers.

Attention is directed to the advertisement in this number of the Richmondt Conduit Mfg. Co., referring to their electro-galvanized and navalite conduit tubing and fittings for interior wiring, the use of which affords safety from fire.

The Canadian General Electric Company have issued an attractive bulletin relating to ceiling fan motors.

A new electric freight locomotive has been purchased by the Galt, Preston & Berlin Electric Railway Company. It is 300 h.p., of the Baldwin-Westinghouse type.

Mr. J. M. Smith, of Toronto, secretary-treasurer of the Sao Paulo Tramway, Light and Power Company, has gone on an extended trip to Europe and South America. At Sao Paulo, Brazil, he will spend some time in looking over the properties of the Sao Paulo Tramway, Light and Power Company, with which he has been identified since its inception.

United States Steel Products Export Co.
Battery Park Building, NEW YORK

Rails and Special Work for Electrical Railways
COPPER RAIL BONDS
With Hollow or Solid Terminals—Applied With Steel Drift Pin or Screw Compressor.
RUBBER AND PAPER INSULATED WIRES AND CABLES
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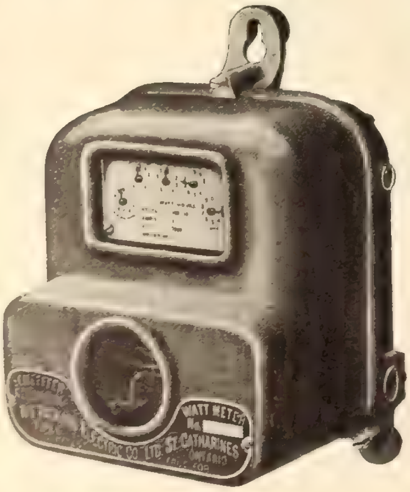
The Packard Type "G" is an Honest Meter



We are prepared to prove this by actual test of this Meter.

We know that TYPE "G" is honest to the buyer and the seller of the current because it measures all the current consumed and no more. It is small and easy to install and maintain.

It is built on substantial lines, is permanently accurate and insures an honest measure of all current consumed.

THE PACKARD ELECTRIC CO., LIMITED,
St. Catharines - - Winnipeg - - Montreal

BROOKER & GOSS LIMITED, LONDON

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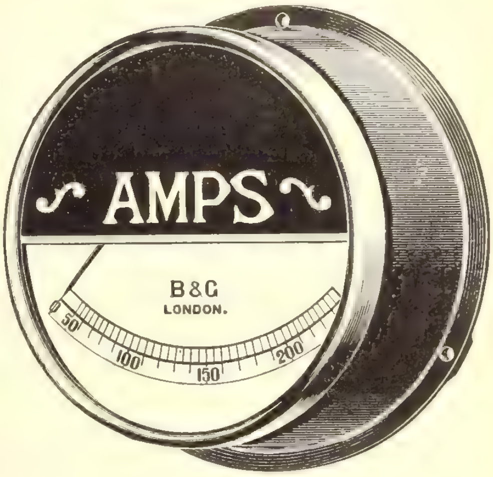
High Class Electrical Instruments

Starting Switches, Switchboards, etc.

Prompt Shipment of all orders within 5 days, any port in U. K.



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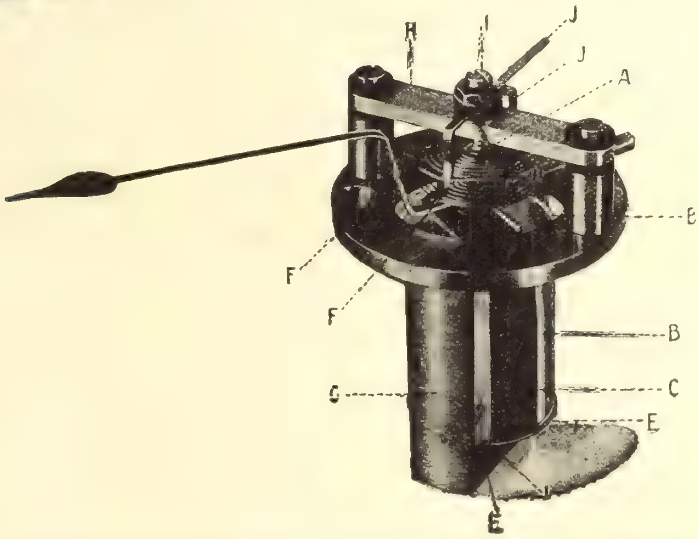
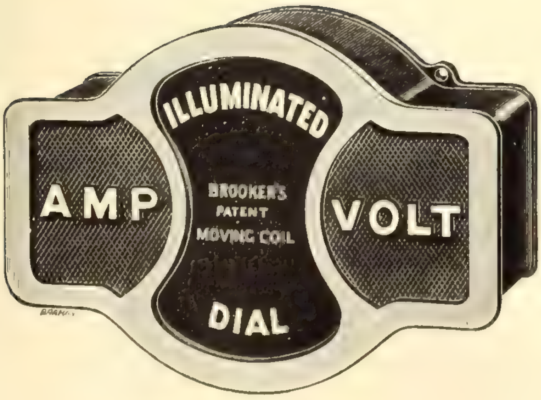
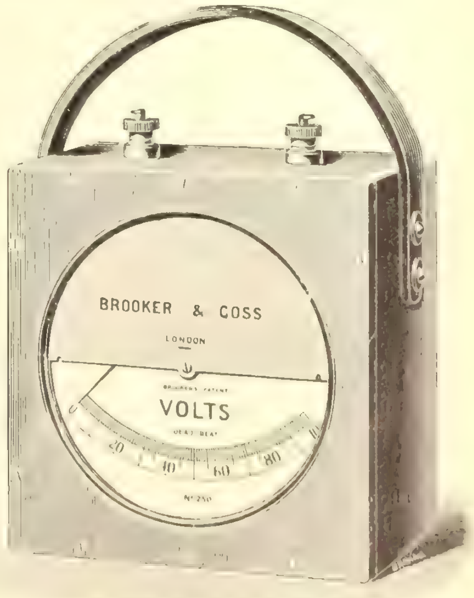


The above illustration shows in detail the construction of Brooker's Patent Moving Coil which is fitted to all our dead beat instruments.

Used by the leading Electrical Firms and Engineers in the U. K.





SOLE EXPORT AGENTS

O. J. Parker & Co., 70 Bishopsgate Street, Within, London, Eng.

REPRESENTATIVES WANTED

SPARKS.

The Elsie Lake Power Company, Limited, has been incorporated at Victoria, B.C.

The Suburban Electric Railway Company will commence building the line from Lambton to Islington in the near future.

Mr. W. N. Dettich, electrical engineer for the C.P.R., is superintending the installation of the electrical machinery in the new shops at Winnipeg.

The management of the Toronto and Scarboro Electric Railway Company are considering the extension of that road to Highland Creek and West Hill.

The Woodstock Electric Railway, Light & Power Company, of Woodstock, N.B., are about to commence the development of a water power on the Meduxnakik river, a branch of the St. John river, about two miles from Woodstock. They have a 25 foot working head and will develop 500 h.p. The plant will consist of two pairs of wheels connected to two generators. It is the intention to have two independent units from the bulk head to the tail race, two feeder pipes, wheel cases, generators, etc. The contract for water wheels and dynamos will be awarded within the next few days. Mr. F. B. Carvell, barrister, of Woodstock, N.B., is interested in the company.

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Courses leading to degrees of Bachelor of Science in Civil, Eectrical and Mechanical Engineering, comprising four years of thorough training and resident collegiate work in theory and practise of engineering. Well equipped shops, laboratories, drafting rooms and power plant. Located near Massena and the engineering developments along the St. Lawrence River. Healthful climate. Tuition moderate.

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In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

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have arranged their works for repair work only. They keep armatures of nearly all makes of dynamos in stock, which they loan while repairs are being made. The factory is so arranged that they can run night and day, and work can be finished in the shortest possible time. **Telephone Main 3149.**

Electric Light Plant For Sale

Dynamos and whole plant modern and paying well. Capable of large increase of business. Liberal terms to party with say $10,000 cash. Address Box 43, CANADIAN ELECTRICAL NEWS.

Young Man (twenty-five), manager of power, lighting and waterworks plant, wishes change of locality. Practical electrician, also familiar with general business details in connection with plants. Would take any position where promotion offered merit. Address "Superintendent," care of CANADIAN ELECTRICAL NEWS, Toronto

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FOR SALE

Ball Electric Light Plant, with connecting wires complete, sixteen arc lamps and globes, all in perfect working order. Will be sold cheap if disposed of quickly. MAPLE LEAF WOOLLEN MILLS CO., LTD., Toronto, Ont.

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MANUFACTURER OF
HIGH GRADE ELECTRICAL MEASURING INSTRUMENTS
ELECTRICAL HEATING DEVICES OF ALL KINDS
S AND SCIENTIFIC SUPPLIES.
ALTERNATING CURRENT VOLTMETER

General Agent in Canada for Whitney Electric Instrument Co

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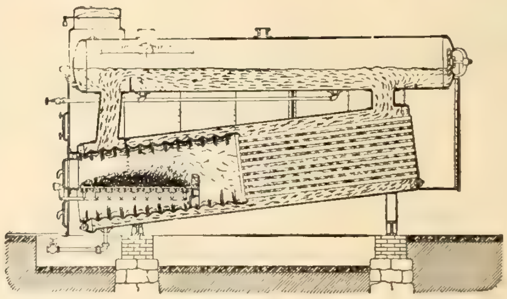
NO HEAT WASTED



The Robb-Mumford Boiler is internally fired and no heat is wasted by radiation as in an externally fired boiler.

The furnace is long and of large diameter with greatest height at the back, giving good combustion.

The boiler is built with a sheet steel case ready for use when it leaves our works, or without case, for bricksetting, as preferred by customer.

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Agents :
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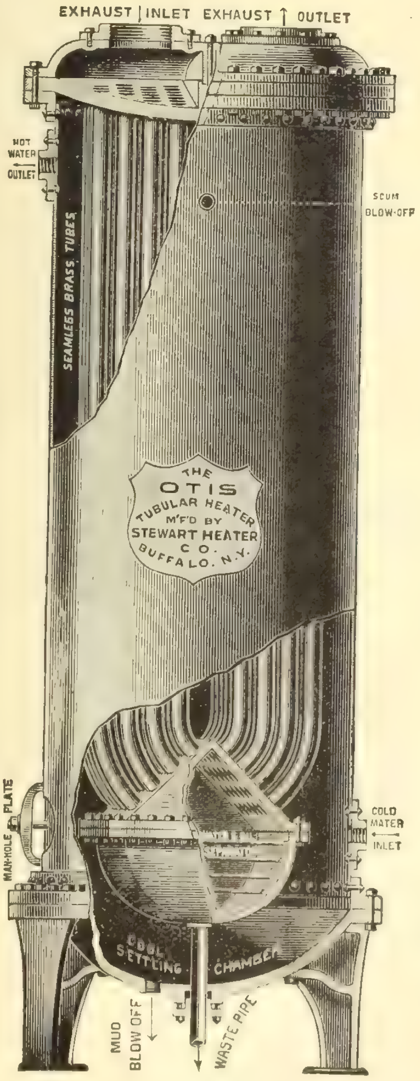
TUBULAR FEED WATER HEATER

Oil Separator and Purifier

is not an experiment but a tried and tested appliance that the makers are not afraid to



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To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, also to extract the oil from the exhaust, so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

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We are so sure of the OTIS that we agree to pay all cost of a trial—freight, cartage, piping, etc., if it fails to do all we claim for it.

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Fred Thomson & Co.

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...Write for our Quotations...

We have the Largest Repair Shop in Canada.

DO NOT SHUT DOWN—we can loan you apparatus while we make repairs

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Quite Conventional—

to draw your attention to our advertisement in this number.

Same old story. Best possible quality and lowest consistent price.

Our stock is larger and more complete than ever, as we have added several new lines, and we would respectfully request the favor of an opportunity of quoting on your requirements when next in the market.

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Street Railway and Electrical Supplies

Mail Orders and Enquiries receive
Special Care and Attention

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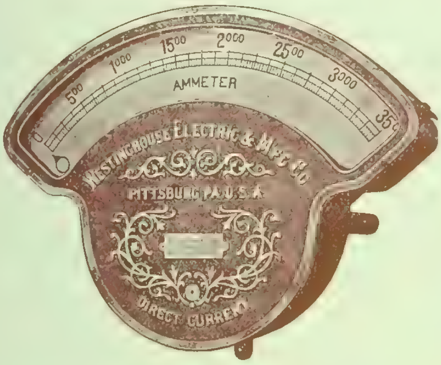

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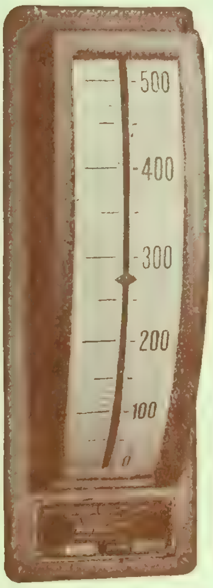
Type E Voltmeter.

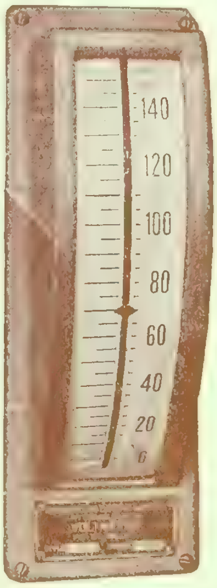
Meet the most exacting requirements.

Accurate and Permanent Calibration.

Perfectly Dead Beat. Allowing the reading to be taken quickly and exactly.



Type H Ammeter.



Type H Voltmeter.

The Moving Element weighs less than that of any other instrument of the kind, friction being a negligible quantity.

Type D Ammeter.

Type D Voltmeter.

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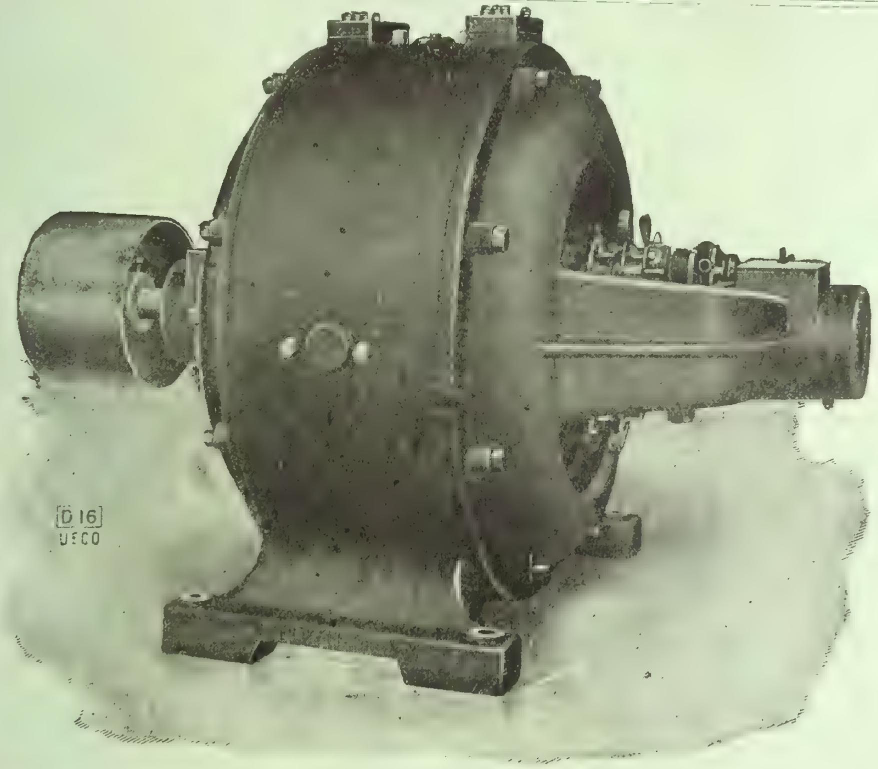

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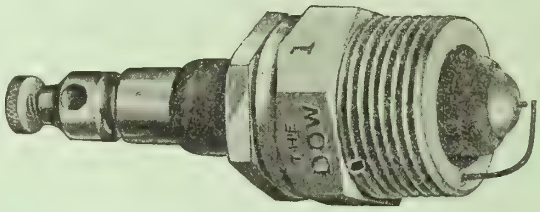

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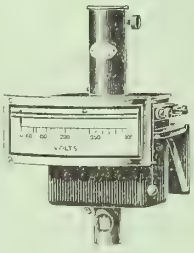

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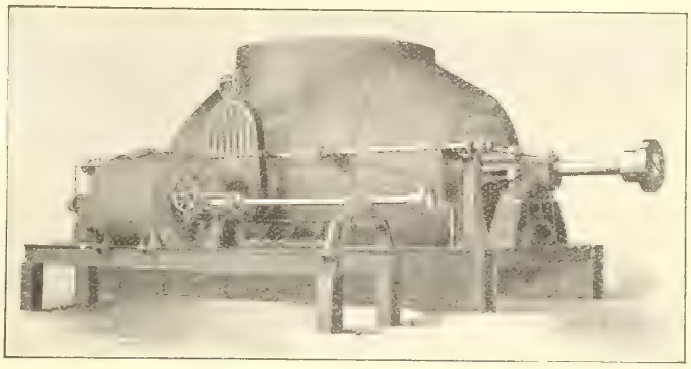

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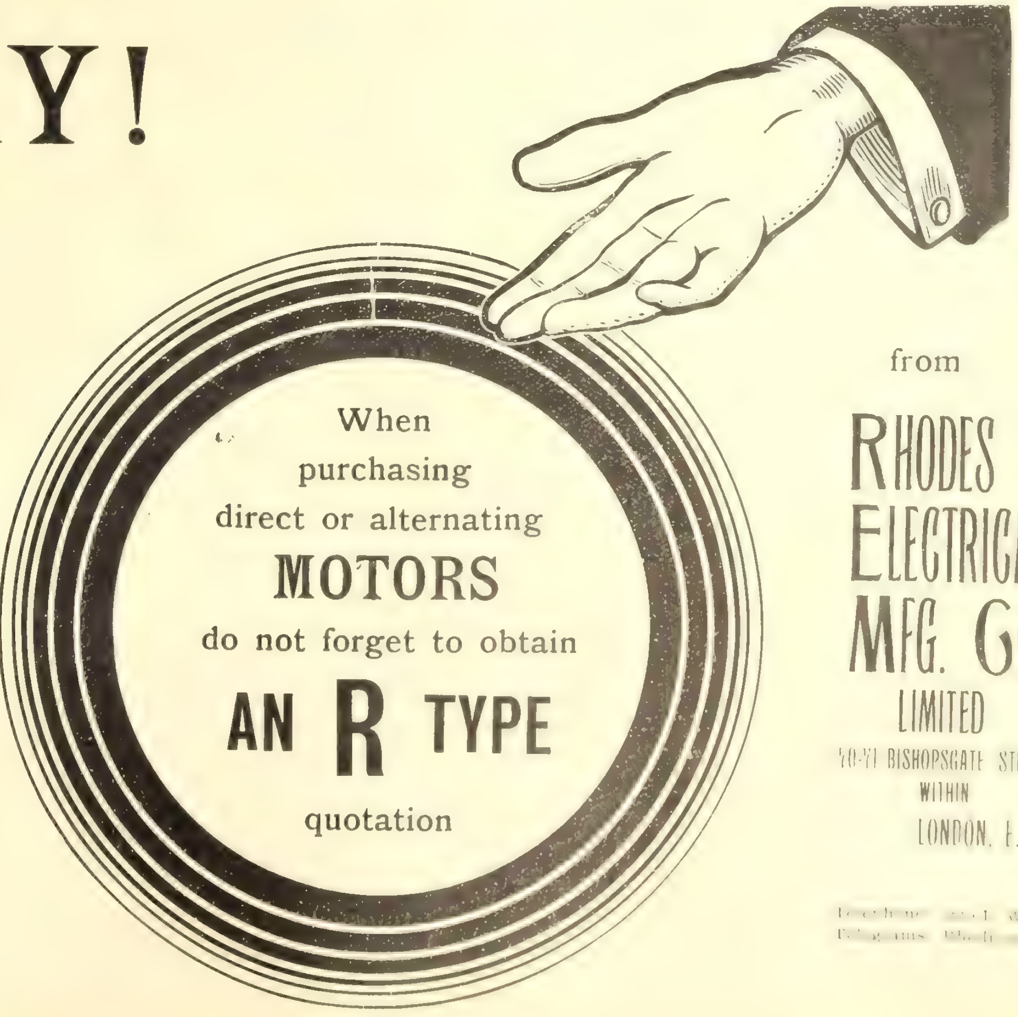

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SPARKS.

The Dominion Government is asking for tenders for the construction of an electrical distribution station for the Welland canal.

The Laurentide Mica Company, which is controlled by the Westinghouse Company, are building a large new factory in Ottawa for the manufacture of mica for electrical purposes.

The Stayner Light and Power Company, Stayner, Ont., purpose developing a water power on the Nottawasaga river, the town council proposing to give the company a loan of $22,000.

The Blindman River Electric Power Company are constructing a dam and flume on the Blindman river near Red Deer, N.W.T., and expect to be able to supply electric power by the fall.

The Dominion Brass Works, Limited, recently incorporated at Port Colborne, Ont., have acquired the Canadian patents for the manufacture of the Huxley valve. The incorporators of this company are Messrs. W. R. P. Parker, E. H. Bickford, S. G. Beckett, W. A. Hare, and H. L. M. Weller, all of Toronto.

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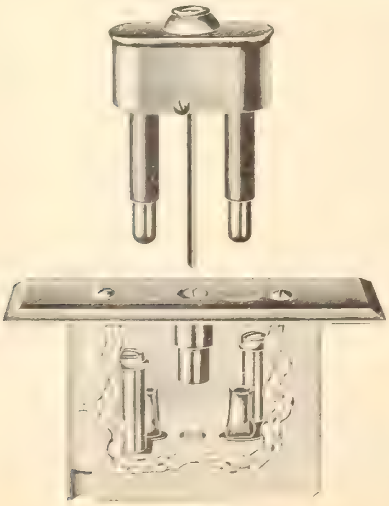

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Pittsburgh Transformer Company,
Pittsburgh, Pa.

Pittsburgh, Pa.
July, 1904.

SPARKS.

Mr. James A. Hicks has registered as proprietor of the business of the Hicks Electric Company, electrical contractors, Montreal,

The ratepayers of Clark Township defeated the by-law to give a $20,000 bonus to the Ontario Electric Railway Company.

The City Council of Chatham, Ont., are considering the remodelling and enlargement of the electric plant, which has not been working satisfactorily of late.

The ratepayers of St. Catharines, Ont., have approved of a by-law granting $20,000 to assist the construction of the Niagara, Queenston, and St. Catharines electric railway.

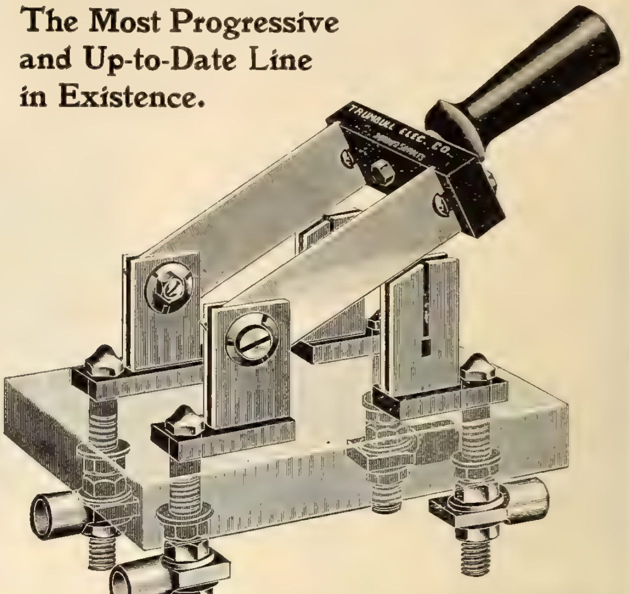
The Bell Telephone Company have been given an exclusive franchise for three years for a telephone system in the City of London, Ont., at the price of $2,500 per year and twenty free 'phones for city use.

The Canadian Adjustable Bearing Company, Limited, has obtained an Ontario charter, with headquarters at Windsor, Ont. The directors include Messrs. J. F. Harrigan and A. W. Atterbury, of Detroit, and F. H. MacPherson, of Windsor.

The Nanaimo Electric Light, Power & Heating Company, Limited, Nanaimo, B.C., has been incorporated. The company has applied for permission to utilize two thousand inches of water on the Millstone river, to be diverted to a power station to be built at Newcastle Town, Vancouver Island.

The annual meeting of the shareholders of the Nova Scotia Telephone Company was held in Halifax recently. The gross revenue for the year amounted to $125,262, as compared with $111,007 for the preceding year. The number of telephones in use is 3,260, an increase for the year of 291.

The Toronto Railway Company have acquired by purchase the Toronto & Mimico Railway Company, the Toronto & Scarboro Electric Railway, Light & Power Company, the Metropolitan Railway Company, the Schomberg & Aurora Railway Company and the Toronto and York Radial Railway Company.



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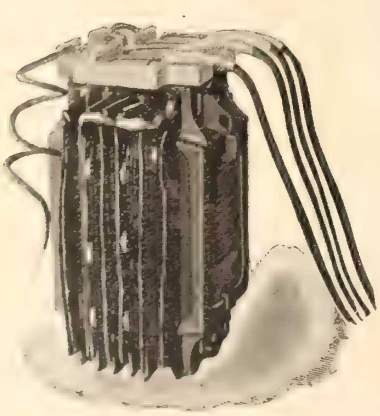

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The Packard Electric Company, Limited
Montreal St. Catharines, Ont. Winnipeg

SPARKS.

The Moyie Lumber and Milling Company, of Moyie, B.C., intend installing an electric plant for lighting their saw mill and yard.

The ratepayers of Wetaskiwin, N.W.T., by a large majority, have declared in favor of municipal ownership of the electric light plant, which will be installed at a cost of $25,000.

A school for teaching telegraphy, stenography and typewriting has been established in Montreal by the Canadian Pacific Railway Company. The scheme is the outcome of intimations made by Sir Thomas Shaughnessy and Manager McNicoll that in all positions pertaining to operation on the road, men with a knowledge of telegraphy would be favored. Rooms have been specially fitted up in which tickers and wires, typewriters, etc., have been installed. There is a teacher in charge of each department.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

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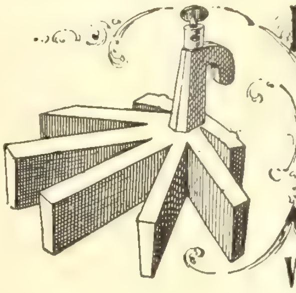

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SPARKS.

A paper on "Steam Turbine Testing at the Westinghouse Works, Pittsburg, Pa.," by Mr. A. G. Christie, was recently read before the Engineers' Club of Toronto by Mr. R. J. Dunlop.

It is announced a that company has been organized, with Hon. H.J. Macdonald as president and Hon. R. P. Roblin as one of the directors to develop a water power at Lac du Bonnet, Man. The company is capitalized at $2,000,000.

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2-12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.

The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station Hamilton. Will be sold en bloc or separately. For prices and terms address

THE VOLTA ELECTRIC STORAGE CO.,
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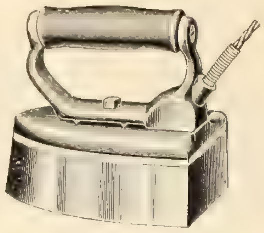

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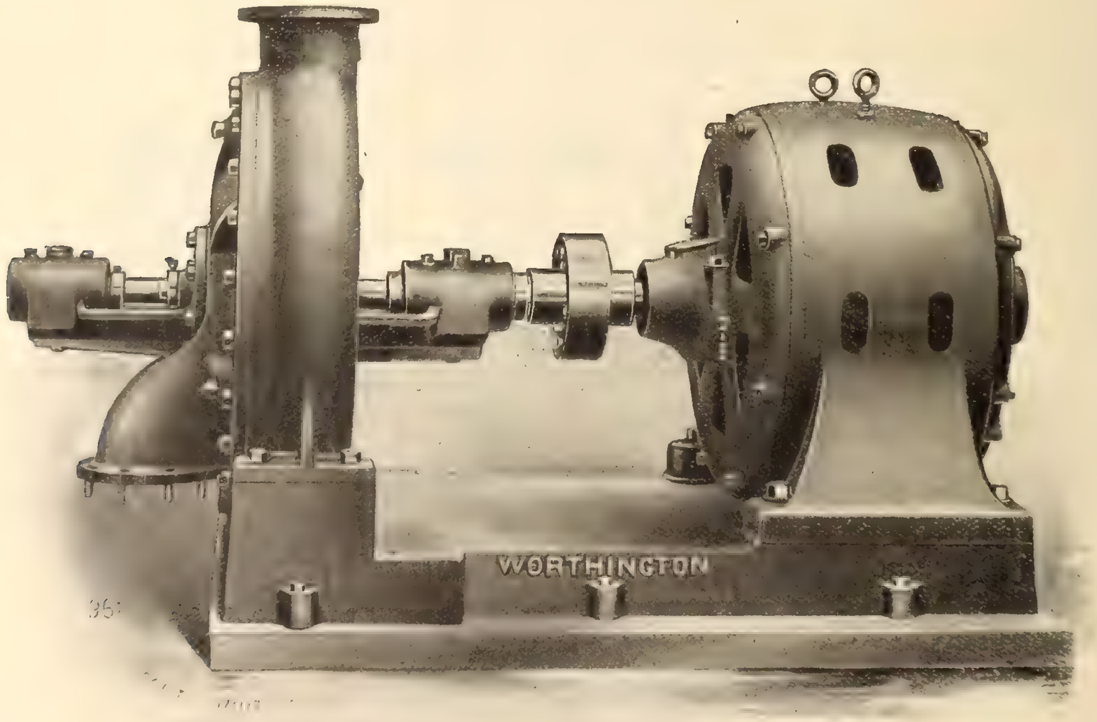

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ANOTHER WESTON PATENT SUSTAINED

Patent No. 497,482 for Shunts for Electric Light and Power Stations sustained by His Honor Judge Holt of the United States Circuit Court, Southern District of New York.

Extract from the opinion of the Court, in the case of the

WESTON ELECTRICAL INSTRUMENT CO. vs. EMPIRE ELECTRICAL INSTRUMENT CO.

"This is a suit to restrain the infringement of a patent, No. 497,482, dated May 16th, 1893, issued by Edward Weston, and now owned by the complainant, for a shunt for electric light and power stations. There are no questions as to jurisdictions, parties or title. **The proof of infringement is conclusive, and is not controverted.** . . . Prior to Weston's patent in 1893, no practical method for the use of a shunt in connection with the measuring instruments for such large currents had been found, although the necessity for such an instrument was thoroughly appreciated, **and many electricians all over the world attempted to invent one.** In actual practice no shunt at that time was used. The measuring instrument was applied to the entire current, but the result was unsatisfactory. The measuring instruments were complicated, inconvenient and expensive, and the measurements which could be made by them were inaccurate and unsatisfactory.

"**The essential problem in discovering a shunt which could be used with a powerful current was not electrical but thermal.** . . . The instruments manufactured under Weston's patent **immediately entered into substantially universal use** in all large central electric power and light stations, and have ever since been used almost exclusively as ammeters of large electric currents. . . . All the shunts relied upon by the defendants were shunts which made no use of the methods which Weston used to dissipate the heat in the case of a large current. **None of them had struck upon the idea of making the plates of high resistance short, so that the heat in them would be rapidly absorbed by the terminals, and none of them had hit upon the idea of making the terminals massive,** so that they would radiate a large amount of heat rapidly from the plates of high resistance. **I think that Weston's patent not only embodies invention, but that it embodies invention of a very high and superior order. It adopted a method of dissipating heat which was not only novel, but was in a line entirely opposite to the direction in which all other electricians had been working.** . . . La Roche testified that he constructed in or about 1884 an instrument called a voltmeter, and a shunt, and that from 1884 until about 1888 or 1889, he used this shunt in connection with this voltmeter as a measuring instrument, for the purpose particularly of testing storage batteries, at his workshop in Germantown or Philadelphia. . . . The evidence establishes, in my opinion, that the instrument called a voltmeter, was formed by putting together a number of instruments or parts embodying different inventions, none of which had been made or was known to electricians before Weston applied for his patent ; that it would have been a marvelous and almost impossible thing for the most skilful electrical inventor at that time to have devised such an instrument ; that La Roche is a man not only without any scientific education, but without even the ordinary knowledge of a skilful electrical machanic ; that his reputation for veracity is bad ; **that his shunt never was used as a measuring instrument in connection with his voltmeter between 1884 and 1889 ; that the various pieces of apparatus constituting the voltmeter were put together by La Roche after the issue of the patent in suit to Weston with the object of being used in support of his own untruthful testimony** to be given in this and other suits for the purpose of attempting to invalidate this and other patents issued to Weston ; **that a part of the apparatus contained in the said voltmeter are two magnets, which are so arranged that their poles neutralize each other ; that as a result it is impossible for a current of electricity in passing through the instrument to move the coil ; that therefore the instrument is and always has been inoperative,and that the shunt could not have been used as a measuring instrument in connection with it.** In short, I can not avoid the conclusion that the testimony of La Roche in this case was deliberately and intentionally untruthful, and that to support it he deliberately fabricated an instrument to be used upon this trial and other trials involving Weston's patents. **It was a careful, premeditated and elaborate attempt by untruthful testimony, fortified by fabricated exhibits, to deprive Weston of his just rights in his inventions, to impose upon this Court, and to pervert the course of justice. I direct that the evidence and exhibits in this case be submitted to the District Attorney in order that he may take under consideration the question whether a prosecution should be brought against La Roche for perjury."**

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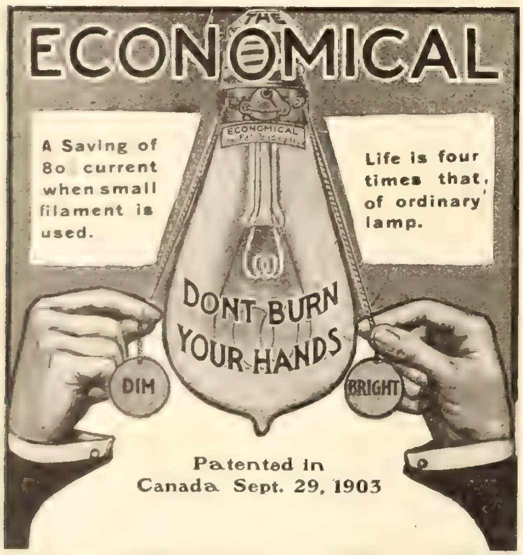
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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIV. JULY, 1904 No. 7.

MR. K. B. THORNTON.

Mr. K. B. Thornton, the new president of the Canadian Electrical Association, well deserves the honor which has been conferred upon him. He has been an active member of the Association for some years and served as its second and first vice-president respectively, and his election as its chief executive officer is decidedly popular.

MR. K. B. THORNTON,
President of the Canadian Electrical Association.

Mr. Thornton was born in June, 1873, in the city of Montreal, Canada, but owing to the removal of his family to England in 1874, he was educated in London, England. After taking a three years' course in electrical and mechanical engineering at the Central Institution, South Kensington, London, Eng., he returned to Canada in 1893 and entered the employ of the Royal Electric Company, Montreal, working in the testing department and shops of that company. In 1895 he was transferred to the electrical operating department of the Royal Electric Company, and from that date to the present time he has been engaged in the supply and distribution of electric light and power in the city of Montreal, being now superintendent of the operating construction department of the Montreal Light, Heat & Power Company, which company has the entire monopoly for light and power in the city of Montreal and surrounding municipalities. He is an Associate Member of the American Institute of Electrical Engineers and also of the Canadian Society of Civil Engineers.

Mr. Thornton was last month united in matrimony to Miss Grier, of Montreal. The ceremony was performed by his father, who came over from England especially to perform the pleasant function. The employees of the Montreal Light, Heat & Power Company presented Mr. Thornton with a handsome testimonial as evidence of their good will and respect on the happy occasion.

NEW TYPE OF GAS ENGINE.

A new type of gas engine, designed by Mr. Adolf Vogt, has lately received considerable attention in London. Only a model has yet been constructed, but with it a horse-power hour is developed with 16 to 18 cubic feet of city gas, a remarkable record for a motor with a cylinder a trifle over 3 inches in diameter and less than 6 inches long. This cylinder has an upright chamber at each end containing air, gas and exhaust valves. The cylinder and the lower part of each chamber are filled with water. The charge is compressed by the water in the upper part of the chamber and on ignition the pressure is immediately communicated through the water to the piston. There are two explosions to each revolution, so that the motor resembles a steam engine in this respect. The valves are mechanically actuated and there is a special device for insuring the presence of the proper amount of water on each side of the piston. The gas and air are supplied by pumps, and the quality of the mixture and the degree of the compression remain constant. The engine runs very cool without water jackets, which simplifies the construction, the air and exhaust valves are cooled by water submerging them once every stroke, and the gas valve is cooled by the inflowing and expanding gas. Whether a large engine can be operated on such a system remains to be demonstrated. The difficulty of making the water act properly when it is present in the large volume needed in an engine of fair size is certainly great enough to warrant withholding an opinion on the commercial value of the motor until experiments on a working engine are made.

The North Shore Power Company of Three Rivers, Que., are adding to their equipment, and by 1st September next will have increased their capacity by 1,000 h.p.

Annual Convention of the Canadian Electrical Association

THE fourteenth annual convention of the Canadian Electrical Association was held at the Royal Hotel, Hamilton, Ontario, on Wednesday, Thursday and Friday, June 15th, 16th and 17th, 1904.

At 11 o'clock a. m. on Wednesday, the President, Mr. J. J. Wright, Toronto, took the chair and called the meeting to order.

The following persons were registered as being in attendance :

A

J. G. Archibald, Woodstock, Ont., Supt. Electric Light System.
C. H. Abbott, St. John, N.B., R. E. T. Pringle Co.
K. L. Aitken, Toronto, Chief Engineer Electrical Supervision Society.

B

Henry D. Bayne, Montreal, Canadian Westinghouse Co.
W. A. Bucke, Toronto, Canadian General Electric Co.
R. G. Black, Toronto, Supt. Toronto Electric Light Co.
W. W. Bogart, Toronto, R. E. T. Pringle Co.
T. H. Bibber, Boston, Mass., American Circular Loom Co.
Geo. Black, Hamilton, G.N.W. Telegraph Co.
Acton Burrows, Toronto, Railway and Shipping World.
N. S. Braden, Hamilton, Canadian Westinghouse Co.
H. M. Bostwick, Hamilton, Canadian Westinghouse Co.
W. C. Brown, Montreal, Consulting Engineer.
E. B. Biggar, Toronto, Canadian Engineer.
E. J. Bengough, Toronto, Cnadian Engineer.
Jas. Buchanan, Galt, Ont., Goldie & McCulloch Co.
T. Beecroft, Barrie, Ont., Municipal Electric Plant.
W. A. Boys, Barrie, Ont., Municipal Electric Plant.
T. H. Bennett, Barrie Ont., Municipal Electric Plant.
James Bannon, Toronto, Chief Engineer Municipal and County Building.

C

J. W. Crawford, Durham, Ont., Mgr. Durham Electric Light Co.
Alfred Collyer, Montreal, Allis-Chalmers Bullock Co.
J. W. Campbell, Toronto, Canadian General Electric Co.
C. H. Clark, Boston, Mass., C. S. Knowles.
F. Chown, Stratford, Stratford Gas Co.
J. A. Culverwell, Peterboro, Ont., Central Ontario Power Co.
V. B. Coleman, Port Hope, Ont., Port Hope Electric Light and Power Co.
E. Craig, Niagara Falls, Ont.
J. W. Crosby, Halifax, Manager Halifax Tramway Co.
P. S. Coate, Chatham, Manager Chatham Gas Co.

D

A. A. Dion, Ottawa Electric Co., Ottawa.
H. N. Dignum, Bowmanville, Ont.
A. T. Duncan, St. Catharines, Ont., Lincoln Electric Light Co.
Frank T. Dryden, Toronto, Canadian Westinghouse Co.
W. H. Dudley, Toronto, Canadian General Electric Co.
H. P. Douglas, Hamilton, General Manager Otis Elevator Co.
Arthur Doddridge, Quebec, Que., Superintendent Quebec Railway Light and Power Co.
Cecil Doutre, Montreal, John Forman.
W. A. Duff, Montreal, Canadian Westinghouse Co.
J. M. Deagle, Cataract, Ont., Electric Light Co.
Fred Deagle, Eugenia Falls, Electric Light Department.
E. W. Davies, Toronto, Electrician.

E

H. O. Edwards, Toronto, Canadian General Electric Co.
A. E. Esling, Toronto, R. E. T. Pringle Co.

F

T. R. Fulton, Montreal, Eugene Phillips Electrical Works
H. O. Fisk, Peterboro, Ont., Superintendent Peterboro Light and Power Co.
R. H. Fraser, Toronto, Gould Storage Battery Co.
J. A. Fletcher, Montreal, R. E. T. Pringle Co.
Chas. L. Farrer, Lakefield, Ont., Lakefield Electric Light Co.
W. H. Fiske, Toronto, Toronto Railway Co.

G

C. K. Green, Hamilton, Superintendent Hamilton, Grimsby and Beamsville Railway Co.
L. R. Grimshaw, St. Catharines, Packard Electric Co.
T. E. Gayfer, Ingersoll Electric Light and Power Department

H

Gordon J. Henderson, Hamilton Cataract Power Co.
C. B. Hunt, London, Ont., Manager London Elecric Co.
K. Hadin, London, Eng., Fueller-Wenstrom Co.
R. B. Hamilton, St. Catharines, Ont., Mgr. Packard Electric Co.
D. S. Henderson, Hamilton, Ont.
C. W. Henderson, Montreal, Canadian Westinghouse Co.
W. C. Hawkins, Hamilton, Hamilton Cataract Power Co.
T. Hilliard, Ottawa, Canadian General Electric Co.
P. E. Hart, Toronto, Canadian General Electric Co.
O. Higman, Ottawa, Inland Revenue Department.
G. W. Hill, Toronto, Canadian General Electric Co.
G. U. G. Holman, Levis, P.Q., Levis County Railway.
J. Herbert Hall, Toronto, Richmond Conduit Co.
L. B. Hastings, Pittsfield, Mass., Erecting Engineer Stanley Electric Manufacturing Co.

I

E. Irving, Toronto, Manager Sunbeam Incandescent Lamp Co
W. J. Ingram, Kincardine, Corporation Electric Plant.

J

J. Johnston, Ottawa, Public Works Department.

K

J. A. Kammerer, Toronto, Hamilton Cataract Power Co.
John Knox, Hamilton.
John Knox, Jr., Hamilton.
S. T. Kelley, Barrie, Ont., Electrician.

L

J. M. Leamy, Toronto, Canadian Westinghouse Co.
T. D. Loneragan, Chateau Frontenac, Quebec, Electrician.
A. C. Larkin, Toronto, Babcox & Wilcox, Limited.
J. D. Lachapelle, Sorel, Que., Electrical Engineer R. & O. Navigation Co.
A. B. Lambe, Toronto, Canadian General Electric Co.
P. M. Lincoln, Pittsburg, Pa., Westinghouse Electric & Manufacturing Co.
W. Langford, Quebec, Mechanical Engineer Quebec Railway, Light & Power Co.

M

C. H. Mortimer, Toronto, Secretary-Treasurer Canadian Electrical Association.
A. McLean, Montreal, Que., Robb Engineering Co.
E. B. Merrill, Toronto, Electrical Engineer.
John Murphy, Ottawa, Ottawa Electric Co.
H. W. McPhie, Hamilton, Assistant Government Inspector.
T. J. Mullen, Montreal, Allis-Chalmers Bullock, Limited.
D. H. McDougal, Toronto, Toronto-Niagara Power Co.
F. W. Martin, St. Catharines, Ont., The Martin Electric Supply and Contracting Co.
D. W. McLaren, Montreal, J. C. McLaren Belting Co.
A. F. McBean, St. Catharines, Ont., Lincoln Electric Light & Power Co.
E. D. McCormack, Toronto, Canadian General Electric Co.
W. L. McFarlane, Cornwall.
R. T. MacKeen, Toronto, Canadian General Electric Co.
W. M. McKay, Toronto, Robb Engineering Co.
W. McCaffery, Toronto, Canadian General Electric Co.

N

T. F. Niven, Hamilton, Otis Elevator Co.
H. G. Nicholls, Toronto, Canadian General Electric Co.
Frederic Nicholas, Toronto, General Manager Canadian General Electric Co.

O

A. H. Oestreich, Waterloo, Ont., Electric Light & Power Plant.
G. H. Olney, Montreal, Secretary-Treasurer Eugene F. Phillipps Electrical Works.

P

T. R. Price, Toronto, Sunbeam Incandescent Lamp Co.
Louis W. Pratt, Brantford, Brantford Electric & Operating Co.
John Patterson, Hamilton, Hamilton Cataract Power Co.
Simon Plewes, Creemore, Ont.
G. F. Perry, Toronto, Canada Foundry Co.
Roderick J. Parke, Toronto, Consulting Engineer.

R

B. F. Reesor, Lindsay, Ont., Manager Lindsay Electric Light & Power Co.
W. H. Reesor, Lindsay, Ont., Lindsay Light & Power Co.
C. B. Roulet, New York, N.Y., Osborn Flexible Conductor Co.
W. H. Reynolds, Montreal, Canadian General Electric Co.
F. Rose, Toronto, Canadian General Electric Co.
L. Rosseau, Montreal, Crescent Electric Co.
G. C. Rough, Montreal, Packard Electric Co.
W. R. Reynolds, Mitchell, Ont., Electrician Municipal Plant.

S

A. B. Smith, Toronto, G.N.W. Telegraph Co.
R. J. Smith, Perth, Ont., Superintendent Canadian Electric & Water Power Co.
Edward F. Sise, Montreal, The Wire and Cable Co.
R. M. Saxby, Whitby, Ont., Superintendent Electric Light and Water Department.
C. T. Starr, Halifax, N.S., Canadian Westinghouse Co.
R. A. Stinson, Montreal, Allis-Chalmers-Bullock.
H. J. Surtees, Toronto.

A. H. Skene, Bracebridge, Ont., Superintendent Electric Light and Power Department.
F. C. Smallpiece, Peterboro, Canadian General Electric Co.
C. W. Schiedel, Waterloo, Ont., Electric Light & Power Plant.
W. R. Scadding, Toronto, Canada Foundry Co.
R. B. Smith, Boston, Mass., Lombard Governor Co.
Paul Sise, Montreal, Canadian Westinghouse Co.

T

J. P. Thompson, Toronto, Eugene Phillips Electrical Works.
K. B. Thornton, Montreal, Montreal Light, Heat and Power Co.
Fred Thomson, Montreal, Fred Thomson & Co.
E. F. Terman, Cataract, Ont., Electric Light Deparment.

U

F. B. Utley, Galt, Ont., The Goldie & McCulloch Co.

W

J. J. Wright, Toronto, Manager Toronto Electric Light Co.
A. A. Wright, Renfrew, Ont., Renfrew Light & Power Co.
A. E. Wilson, Montreal, John Forman.
W. Williams, Sarnia, Ont., Manager Sarnia Gas & Electric Co.
J. M. Wright, Montreal, R. E. T. Pringle Company.
W. V. Warren, Toronto, Allis-Chalmers-Bullock.
F. C. Whatmough, Stratford, Ont.
W. H. Wiggs, Quebec, Mechanics Supply Co.
R. R. Wiley, St. Catharines, Ont., Packard Electric Co.
H. Webster, Norwich, Electric Light Plant.
John W. Watts, Toronto, Canadian General Electric Co.
W. D. Wilgar, Toronto, Canadian General Electric Co.
E. B. Walker, Toronto, Canadian General Electric Co.
H. W. Weller, Montreal, Babcox & Wilcox, Limited.
A. M. Wickens, Toronto, Canadian Casualty and Boiler Inspection Co.
C. H. Wright, Toronto, Canadian General Electric Co.
J. F. H. Wyse, Toronto, Canadian Westinghouse Co
A. Walker, Bracebridge, Ont., Superintendent Electric Light & Power Department.

Y

John Yule, Guelph, Ont., Manager Guelph Light & Power Co.

The Secretary, Mr. C. H. Mortimer, read the minutes of the last meeting.

The President : Gentlemen of the Convention, before proceeding with the orders of the day, I would like to take this opportunity, the first I have had, of expressing my thanks to you for the honor you have done me in electing me President of the Association. I imagine that at the time of the election you were taking pretty long chances on a President. All the same, under the circumstances, I deeply appreciate the honor you did me and your rememberance of me at that time. I will now call upon the Mayor to say a few words.

Mayor Morden : Gentlemen—As Mayor of the City of Hamilton I am gratified to welcome and extend to you the freedom of what, our citizens are proud to believe, is one of the most progressive and prosperous industrial and commercial centres of the whole Dominion. Situated as we are, on Canada's magnificent waterway, extending from the upper lakes to the seaboard, and with the excellent facilities which we possess in connection with the two great railway systems of Canada, the Grand Trunk and Canadian Pacific, along with connections of a direct sort with the leading American roads, we are rapidly becoming a very important and large distributing point for Old and New Ontario, the great North-west and Pacific coast shipments. As a manufacturing and commercial centre Hamilton has no superior. Once Hamilton was known as the ambitious city, but there is a difference now. It then had an ambition to be great among the cities of Canada ; it now has an ambition to be the greatest of them all. Toward this goal we have progressed to such a degree as to have attracted the attention of the manufacturing world to the great advantages which we possess, and which already have secured for us some of the largest manufacturing industries on the continent. The evidences of that progress are before you on every side. Our population is rapidly increasing ; our manufacturing concerns are being added to constantly, and to-day I am glad to tell you that more than three hundred important industries of different kinds are in operation within our city limits. As an evidence of this I may state that during the present year we shall probably add fully 5,000 wage earners to the thousands of our population already profitably engaged in these useful arts. No city in the province shows indication of having such an era of prosperity in industrial development as the City of Hamilton. American capital is being invested by the millions in the construction of immense manufacturing establishments, and we venture to assert that in a very few years fully fifty per cent., if not more, will be added to our population. As I understand it, the object of this Association is to organize so that matters affecting the trade can be discussed by an authoritative body. This, together with careful, prudent, business-like methods in administration, is well calculated to raise the standard of your Association and compel admiration as well as implicit trust in its resources and safety. I trust that your deliberations here may be characteristic of your surroundings, progressive and harmonious. In conclusion, I desire to congratulate your organization on the success that has hitherto attended your efforts, and wish you every prosperity in the future. I regret your stay with us is of such short duration, but we hope you will carry away with you, on leaving for your respective homes, the most pleasant recollections of your brief visit to Hamilton, and that many future sessions will be held in this city. (Applause).

The President : On behalf of the Canadian Electrical Association, I thank you and the Council and the citizens of Hamilton for the very cordial and generous welcome you have given us to your city. It is now twelve years ago since the first convention of this Association was held in Hamilton, and amongst other things that prompted us to hold our convention in this city was the reputation for hospitality enjoyed by your citizens. When we came here we were not disappointed, and I am sure also that we shall carry away with us pleasant remembrances of this convention. I thank you again for the hearty and generous welcome you have given us.

PRESIDENT'S ADDRESS.

To the Members of the Canadian Electrical Association:

GENTLEMEN,—Just twelve years ago to-day, the fifteenth of June, 1892, the first convention of the Canadian Electrical Association was held in the City of Hamilton. It was a modest little Association then and the weightiest matter that was exploited at that meeting was an attempt to determine the candle power of arc lamps. Even the City of Hamilton was not as large then as it has since become, and, although at that time recognized as the Birmingham of Canada, had not attained the distinction it now enjoys as the Electric City and one of the first to minister to the needs of its manufacturers by transmitting electric power from the reservoir to be found above the Niagara peninsula. It may be said that the interval which has elapsed between the holding of our first Convention in this city and the present time, covers practically the entire development of long distance transmission of electricity. These have been twelve strenuous years in electrical development and what was then a very weak and puny infant has grown into a giant like Braireus with a hundred arms.

I shall not detain you with any platitudes upon this remarkable progress. Its results are to be seen upon every hand, on the railroad, in the workshop, in the storehouse, in the dwelling, and these results are eloquent realities that cannot fail to impress themselves upon the most thoughtless.

Among the more important matters that should engage your attention, I think, should be an endorsation of the application made to the Minister of Inland Revenue for the better utilization of the resources of the Inspection Bureau of the Government. The Department should be made of much more benefit to the members of this Association than it now is. The favorable hearing accorded to the deputation which waited upon the Minister a few weeks ago, was such as to give encouragement that a further application would secure to us increased facilities for the protection of our work, and also legislation which would still further protect the companies engaged in electrical enterprises.

We also have, I believe, a committee appointed to confer with the Underwriters. I presume this committee was appointed principally to agree upon protective devices to be used in the installation of electric appliances generally, but I think it could do good work if it were to succeed in inducing the insurance companies to investigate thoroughly the cause of the many fires that are continually taking place. It has become the fashion now, whenever there are wires in a building, to blame all fires upon the electric wires where there is no other obvious explanation. Insurance companies do not pay sufficient attention to what may be called the moral risk in their business, and by their readiness to accept the wire theory, are simply encouraging the unscrupulous to take advantage of them. The Chief of the Fire Department of this city has said that 60 per cent. of the fires that take place are of incendiary origin. I am of the opinion that if anything his estimate is too low and if the cause is, in many cases, not absolutely direct arson, it is criminal carelessness, not many removes from it. Whether it may be possible to remove the prejudice from the minds of the insurance men to such an extent as to have them recognize that their blind acceptance of the wire theory without investigation is simply an encouragement to the careless or fraudulent insurer, it is difficult to say, but at any rate it is worthy of an effort by this Association.

I am pleased to note that the legislation which requires a municipality to purchase at a fair valuation the plant of a company with whom it would otherwise go into competition still remains upon the statute books of the province. There appears to be a growing tendency on the part of the Municipal Socialist to endeavor to obtain the control of what they please to term public utilities, but while this legislation remains in force I do not see anything for the capitalist to be alarmed at in this passing whim. I think it is much to his advantage that he lets the municipality take the risk of depreciation in an uncertain business while he can provide the funds for the debentures, the returns on which are absolutely guaranteed to him by a mortgage on every bit of property in the municipality. He gets his dividend without effort and lets the other party do the necessary worrying. What the taxpayer may have to say later is another matter. It only requires a few more failures on the part of Canadian municipalities such as are now becoming manifest, to disgust the payer of taxes with municipal socialism. Theoretically a municipality should be able to equal private enterprise, but practically it is impossible In some isolated cases in England it has been accomplished with more or less success, but the difference in constitution of municipal bodies to be found in England and Canada is quite sufficient to account for the impossibility of such results being attained here as we see accomplished on the other side of the water.

We have many important and interesting matters to engage our attention at this convention. The Question Box inaugurated at the last meeting has, under the able guidance of its Editor, Mr. Dion of Ottawa, developed into an institution giving promise of much interest and usefulness. There are valuable suggestions contained in it that I hope will receive the earnest attention of the convention. Our time is somewhat limited, but if we do our best to avoid any discursive delays we may hope to cover the ground in an efficient manner. I may mention as one of the very interesting subjects to be brought to our attention, the address to be given this evening by Mr. Aitken on the Niagara power development. This talk is to be illustrated by lantern views of the various works. I hope the members will all avail themselves of the information to be there gathered, as it will be a useful preparation for the visit on Friday to the actual scene of operations and will enable us to profit by that visit in a manner we perhaps could not otherwise do.

Another timely subject to be brought before us, which will also be illustrated, is the paper on the Curtis turbine, by Mr. Smallpiece. It may be thought that with the enormous development in Canada of the various water powers that the subject of steam as a prime mover might be somewhat out of date. I do not think so. The necessity of reserve power to supplement the transmission line has been demonstrated to be a necessity. The peculiar adaptability of the turbine form of engine and generator for this purpose in many ways, as well as its economic merit, stamps it without doubt the engine of the future.

There are many other interesting matters to be discussed but which I will not refer to specially, as they will be brought forward from time to time for your attention. I will merely refer briefly to the progress made by our Association since the meeting I had the honor of presiding over twelve years ago. Its members then numbered about a hundred; we have now on the roll over four hundred members. In setting forth the objects of the Association at that time attention was called to the fact that the large amount of capital invested in electrical enterprises had not received the return that its investors had a right to expect, and that the protection of that capital should, therefore, be one of the chief aims of the organization. I am glad to say that the Association has been successful in its aims and if the protection of the interests of its members from destructive attacks that has been obtained at the hands of the Legislature of the Province of Ontario had been its sole accomplishment, the existence of the Association has been more than justified. I will say further, as I said then, that I am anxious to see this Association, which was inaugurated under such promising conditions, become even a greater power in the land. Under the guidance of the younger and more energetic of its members it should become something more than an ornamental name. It should attain to sufficient influence to be referred to as an arbitrator whose decisions should be respected as final and weighty, and its annual gathering be looked forward to as the leading event of the year.

SECRETARY TREASURER'S REPORT.

The following report was presented by the secretary, Mr. C. H. Mortimer :

On November 26th last the Executive met and closed up all business relating to the Toronto convention of 1903. A cheque for $99.83 was received from the Local Committee in connection with the last convention, with the suggestion that the money be applied towards entertainment expenses of this convention. The Executive adopted this suggestion, and by resolution expressed its thanks for the money.

Messrs. R. G. Black (Convenor), J. A. Kammerer, K. B. Thornton, A. B. Smith, the President and the Secretary were appointed a committee to procure papers for this convention.

Mr. A. A. Dion was appointed Editor of the Question Box, and the funds necessary to properly carry on his work were voted.

Considerable discussion took place with regard to means whereby the usefulness of the Association might be increased, and a number of suggestions were made for this object. It was felt that the Question Box would prove a valuable feature, and that the correspondence in connection therewith should bring the members into closer contact, and widen and enhance interest in the organization.

At a meeting of the Executive held on April 22nd last, the dates were selected for the present convention, Messrs. Gordon Henderson and J. A. Kammerer being empowered to organize a Local Committee to complete the arrangements.

The first volume of the Question Box has been placed in the hands of the members at this meeting. It embodies information of much value to the members of the Association, and is also highly creditable to the Editor. A limited number of copies of this volume have been given to persons outside the Association who contributed information, but only members of the Association in good standing will receive copies of future editions.

The Association is placed under deep obligation to the authors of the valuable series of papers to be presented at this meeting, advance copies of which have been mailed to all the members.

The membership is still increasing, and interest in the Association widening. The membership now stands at 375 as compared with 344 a year ago, an increase during the year of 31.

The receipts and disbursements for the Association year ending May 31st, 1904, are as follows :—

SECRETARY-TREASURER'S REPORT FOR YEAR ENDING MAY 31, 1904.

RECEIPTS.

Cash on hand June 1st, 1903	$ 28 59	
Cash in Bank	880 58	
151 Active Members' Fees at $3.00	453 00	
32 Associate Members' Fees at $3.00	96 00	
2 Associate Members' Fees at $2.00	4 00	
Surplus Funds in hands of Local Convention Committee, 1903	99 83	
		$1562 00

DISBURSEMENTS.

Postage	$ 27 40	
Stationery	3 40	
Exchange on Cheques	5 80	
Telegrams	1 55	
Duty and Express Charges on Buttons	5 85	
Badges and Buttons	14 85	
Badges for Committee	1 50	
Ribbon for Badges	60	
Express Charges	45	
Expenses of Question Box—A. A. Dion on a/c	50 00	
Grant to Secretary	150 00	
Printing (including 450 copies of Proceedings)	117 95	
Stenographer	30 00	
Grant to Legislation Committee out of Association Funds	300 00	
Paid assistants to Secretary during convention, and to caretaker of rooms	10 00	
Cash on hand	25 04	
Cash in Bank	817 61	
		$1562 00

At the afternoon session Mr. E. B. Walker, of Toronto, read a paper on "The Origin and Development of Storage Batteries," which will be found on Page 132. He stated that the battery companies supply their own electrolyte, which is very carefully tested ; hence, in his paper, he had emphasized the necessity of purity of water more than that of acid, because the former is more in the hands of the user.

Mr. Frederic Nicholls extended an invitation to the members of the association to visit the new storage battery plant which had recently been installed by the Toronto Railway Company.

A paper on "A.C. vs. D.C. Arc Systems" was read by Mr. W. L. McFarlane, of Cornwall, and elicited considerable discussion. It will be found elsewhere in this issue. On being questioned as to the cost of power being $15 per horse power for 24 hours' service, Mr. McFarlane said that the price fixed by his paper was an arbitrary figure and might just as well have been $5 or $100 as $15.

Mr. J. A. Culverwell read a telegram from the mayor of Peterboro inviting the association to hold its next convention at Peterboro in 1905.

The "Question Box," which was very ably edited by Mr. A. A. Dion, was next considered. The many interesting questions brought up aroused considerable discussion, and a hearty vote of thanks was unanimously tendered to Mr. Dion for his efficient services. The published volume of questions and answers was distributed to the members.

Two papers were read at the evening session, one on "The Curtis Steam Turbine," by Mr. Frank C. Smallpiece, Toronto, and the other on "The Niagara Power Development," by Mr. K. L. Aitken, Toronto. Both papers were illustrated with stereopticon views and were much appreciated.

On Thursday afternoon Mr. R. J. Parke, E. E., Toronto, read a paper on "Aluminum Wire as a Conductor." It appears in elaborated form on another page. A paper by Mr. George Johnston, Dominion Statistician, Ottawa, on "Statistics of Electrical Progress in Canada," was taken as read, and Mr. Paul M. Lincoln, of Pittsburg, was asked to read his paper on "Heavy Electric Traction by Alternating Currents." This paper created a very lively discussion and much valuable information was obtained by the members. In reply to questions Mr. Lincoln said that any method of regulating voltage would regulate speed. The rheostat method might be used as well as a number of other methods, such as bringing loops out of the transformer and attaching the motor to different loops. He proposed putting on each car an induction regulator connected between the motors and the transformer, so that by moving the primary of the regulator through an arc of 180 deg., its voltage might be added to or taken from the transformer. The single-phase system had not yet been put into actual service, except on what might be called an experimental line in East Pittsburg. The high voltage trolley was coming, but he did not think it wise to jump from 500 volts to 10,000 volts. He recommended 1,000 or 2,000 volts at present. But on heavy railway lines higher voltage should be used. The trolley voltage for practically all the lines they have sold is 1,000 volts. Step-down stations are provided on the line at intervals of five or seven miles. There is no feeder on the lines, nothing but the trolley.

Mr. C.B. Hunt reported for the Legislation Committee that no fighting had been necessary during the past year, but that it would still be necessary to watch the existing law, which will sooner or later be attacked by a growing agitation for municipal ownership.

After deciding to hold the next convention in Montreal, the following committees were appointed for the ensuing year, with power to add to their number :

Committee on Statistics—A. A. Dion, R. T. McKean, R. G. Black, James Robertson.

Committee to Confer with Underwriters—J.J. Wright, W. C. Hawkins, Ed. A. Evans, A. A. Dion, W. McLea Walbank.

Legislation for Ontario—Charles B. Hunt, A. A. Wright, B. F. Reesor, J. J. Wright, R. O. McCulloch, Gordon J. Henderson.

Legislation for Quebec—A. Sangster, G. U. G. Holman, Ed. A. Evans, K. B. Thornton, with power to add to their number.

The election of officers resulted as follows : President, K. B. Thornton, Montreal ; 1st vice-president, A. A. Wright, M. P., Renfrew ; 2nd vice-president, R. G. Black, Toronto ; secretary-treasurer, C. H. Mortimer, Toronto ; executive committee, A. B. Smith, Toronto ; A. A. Dion, Ottawa ; B. F. Reesor, Lindsay ; J. A. Kammerer, Toronto ; Gordon J. Henderson, Hamilton ; C. B. Hunt, London ; F. Thompson, Montreal ; J. J. Wright, Toronto ; John Murphy, Ottawa ; A. E. Evans, Quebec.

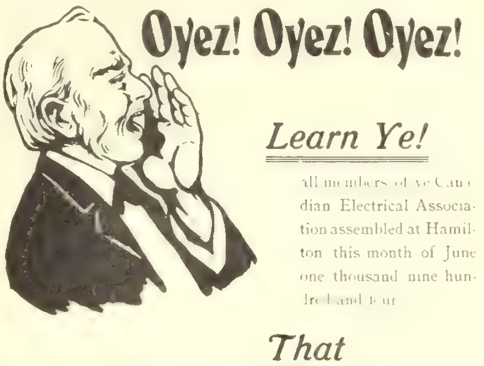
Votes of thanks were tendered to the different companies and persons who had contributed to the success of the meeting, which concluded the business sessions of the convention.

SOCIAL FEATURES.

Thursday forenoon was spent by the delegates in visiting points of interest in Hamilton. The splendid Victoria avenue sub-station of the Hamilton Cataract Power, Light and Traction Company, the immense works under way for the Canadian Westinghouse Company, and the new plant of the International Harvester Company were inspected.

The customary banquet was held at the Hotel Royal on Thursday evening, about 150 being present. Mr. J. J. Wright presided. The toasts included : "The Country We Live In," responded to by Hon. Dr. Montague ; "The City Corporation," by Mayor Morden ; "The Electrical Industries," by Mr. Paul M. Lincoln ; "Our Guests," by Mr. John Knox ; "Our Association," by Mr. A. A. Dion ; "Hamilton, the Electric City," by Hon. J. M. Gibson.

Through the courtesy of the Canadian Westinghouse Company, the delegates witnessed a vaudeville show on Wednesday evening, the announcement of which is reproduced below :



Oyez! Oyez! Oyez!

Learn Ye!

all members of ye Canadian Electrical Association assembled at Hamilton this month of June one thousand nine hundred and four

That

on ye evening of Wednesday ye fifteenth of ye month there will be gathered together at ye

STAR THEATRE
MERRICK STREET, HAMILTON

a company of noble and distinguished Thespians who will cater to your need for relaxation after ye arduous labours of ye day

And to which gathering ye are all bidden

Brought together after careful search and at enormous expense, fresh from their recent triumphs before all ye Crowned Heads of Europe and America, these artists who stand at ye top of ye noble Profession of Dramatic Art-Actors and Actresses, old men, young men, and girls that are not men at all, they will to-night appear together for ye first and last time on this or any other stage. Fun makers whose freaks follies and fancies make folks fall off their seats, make gloom grin, gladness even more glorious and ye weary ones of this world brighter, better and refreshed with recreations revelry. Come one come all bring your buttons, get your tags, and when in doubt consult ye *number thirteen.*

Admission assured to all ye members on presentation of buttons. Tickets for friends may be obtained from ye *number thirteen* or any *Westinghouse henchman.*

Curtain rises at ye ninth hour.
Star Theatre, Hamilton
Wednesday, June fifteenth.

Friday was devoted to a trip to DeCew Falls and Niagara Falls. After inspecting the power house at the former place a luncheon, provided by the Hamilton Cataract Power Company, was partaken of. The 1.21 train from St. Catharines carried the party to Niagara Falls, where a couple of hours were spent in looking over the power plants.

To many the magnitude of the development on the Canadian side was a great surprise, notwithstanding the lucid description given by Mr. Aitken on Wednesday evening.

NOTES.

The Canadian Westinghouse Company and the Canadian General Electric Company had attractive exhibits of electrical apparatus in rooms adjacent to the convention hall.

A souvenir in the form of a pencil was distributed to the delegates by the Sunbeam Incandescent Lamp Company, of Toronto.

A daily programme was handed to the delegates by the Allis-Chamlers-Bullock Company, of Montreal and Toronto. By means of the register contained therein and the numbered buttons worn any delegate could be identified.

INSULATING COMPOSITION.

A composition suitable for electric or heat insulating purposes is made, accoring to a Danish invention, from cork dust, cork waste, peat dust, small peat or similar materials, by saturating the same with water glass, pouring the resulting mass into moulds to set, and then hardening it by boiling in a solution of chloride. The hardened mass is preferably washed or rinsed with water to remove all traces of chloride of lime.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

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The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Canadian Electrical Association The annual meeting of this Association held last month in Hamilton was marked by a good attendance and much interest on the part of the members in the proceedings. The social features instead of being distributed, as in former years, were largely concentrated, thus affording more time for the more important business of the convention. It is becoming more clearly realized every year that the principal object of these meetings should be the consideration of important questions relating to the development of the various branches of the electrical industry, by which much valuable information is imparted. In pursuance of this idea, the social features were properly given a subordinate place in the programme. The papers presented covered a variety of interesting subjects and were of high order of merit. It was found necessary to hold an evening session in order to accomplish the work laid out in the programme. At this session a lantern projector was employed to illustrate the papers by Messrs. Aitken and Smallpiece. These illustrations added materially to the interest, and in the case of Mr. Aitken's paper, gave the members an excellent idea of the great works under construction at Niagara Falls by the Toronto and Niagara Power Company to which a visit was made on the last day of the convention. Much interest was manifested in the Question Box presented to the members for the first time in pamphlet form at this convention, and appreciation was expressed of the excellent work performed by the editor, Mr. A. A. Dion. The visit on the last day of the convention to the power development works of the Hamilton Cataract Power, Light & Traction Company at DeCew Falls, and to the great works of the various power development companies at Niagara Falls, was an event full of interest and one which will be long remembered by those who participated. The members are indebted to the Committee in charge of the local arrangements for this most interesting and enjoyable trip, as well as for the very complete arrangements made for their entertainment and comfort throughout the convention. It is gratifying to note that the membership of the Association shows a further substantial increase, and now stands at about 400. At the time of the first Convention held in Hamilton thirteen years ago it numbered only about 25. Mr. J. J. Wright, who presided at the first convention, had also the privilege of occupying the chair at this meeting and received the congratulations of the members on his complete restoration to health.

CANADIAN AGENTS WANTED.

The attention of Canadian supply firms is called to the list of British exporters published in this number who are desirous of securing reliable agents to place their goods on the Canadian market. Any of our readers who may wish to secure good agencies, would do well to refer to this list and communicate at once with the firms whose names and addresses we publish.

The efficacy of lightning arresters is questioned in a report of a committee of the Berlin Electrical Society. In forty-one cases accidents occurred with all known systems of lightning arresters in use, and in one case four different systems of arresters were used simultaneously. However, experience seems to show, it is stated, that it is desirable to insulate the iron frames of the machines and apparatus from the earth.

A. C. vs. D. C. ARC SYSTEMS.*

By W. L. McFarlane.

For reasons apart from arc lighting, the tendency at present in equipping electric power stations is towards the installation of A. C. generators of large capacity. The source of power may be water or steam, or a combination of both. Having regard to this established tendency we will consider the bearing of the arc system on it and the relative costs and advantages of the different systems.

ARRANGEMENTS AVAILABLE FROM THE DIFFERENT SOURCES OF POWER.

If water power is used, and the frequency of the system is between 40 and 125 cycles, the arc lighting will probably be done either by arc dynamos driven by A. C. motors of the synchronous or induction type, or by transformers operating A. C. arc lamps. If the frequency in use is lower than 40 cycles, the transformer and A. C. arc lamp arrangement will only be practical through the medium of frequency changers. Should engines be the prime movers, A. C. transformers and arc lamps may be used, or arc dynamos may be driven direct from an engine or by motors.

When, as is often the case, a combination of engines and water power has to be used, A. C. transformers and lamps, or motor driven arc dynamos are possible as in the other two cases, there being also the arrangement where the arc dynamos are operated from line shafting to which are connected both an A. C. motor and an engine. By means of suitable clutches or quills, either the motor or the engine can be used to supply the necessary power to the shafting. When mentioning here the A. C. transformers and arc lamps, the series alternating enclosed arc lamp system operating from constant current transformers is meant. Multiple constant potential arc lamps, of both the open and enclosed type, are extensively used for inside lighting, and occasionally for outside street lighting, but only when there is some special reason for so doing. In the case of the D. C. arc system, we have to consider the open and enclosed lamp, and the small arc dynamo and its larger and more modern rival. Generally speaking, there are four systems of series arc lighting at present in use, namely: —

1st. The small arc dynamo supplying about 50 open lamps at 9.6 or 6.6 amperes.

2nd. The larger and more modern arc dynamo supplying as many as 175 open lamps in series, or, by the multi-circuit arrangement.

3rd. Large arc dynamos wound for 6.6 amperes for supplying current to enclosed lamps.

4th. Transformers to which are connected circuits having as many as 100 constant current series alternating enclosed arc lamps.

Whichever one of these systems of arc lighting is in use in a station, in all probability only a small portion of the total energy generated is delivered to the arc system, the larger portion being taken care of by comparatively large A. C. generators arranged with the object of keeping operating, maintenance, and all other costs at a minimum. Under these circumstances we will consider the four different systems of arc lighting mentioned, assuming, for the sake of simplicity, an arc equipment of 500-480 watt lamps, in a station of 3,000 K. W. capacity. For the same reason, and owing to the great difference of opinion on the subject, the induction motor will be considered instead of the synchronous motor; the former, while having a poorer power factor, will be less affected by trouble on the system, besides requiring a much simpler means of control and less experienced attendants than the synchronous motor.

SMALL DYNAMOS OF ABOUT 50 LIGHTS CAPACITY.

For this class of service, about eleven arc dynamos with the necessary shafting and belting, and an engine or motors to drive them will be required, and owing to the space occupied, a special department, or perhaps a special station, will require to be devoted to it, thus incurring special expenses which can only be determined for individual cases. However, three men at least will be required for operating, and as the efficiency of this system will be about 54 per cent., the power required, will be approximately 600 H.P. The conditions of operating necessary for an arc plant of this kind are too well known to require their being mentioned in detail here.

Table No. 1 is intended to show the comparative annual station costs when small arc dynamos are operated under the different conditions of motive power, namely:—Water power with 60 or 25 cycle motors; steam power using an engine direct, or motors obtaining current from large A. C. units; and water power with steam reserve employing a combination of engines and motors. In the extreme right-hand column of this table, the heading is "25 cycle motors driving shafting, the reserve steam power being obtained through frequency changers." No portion of the cost of these frequency changers has been charged to the arc installation, as doubtless frequency changers will have been installed for the incandescent service, and in the event of the 60 cycle steam reserve being required, these frequency changers will be available for use in connection with the motors driving the arc apparatus, changing the 60 cycle steam power to 25 cycles for the motors.

TABLE No. 1.

Showing Comparative Approximate Annual Station Costs, Using Small Arc Dynamos.

Items of Cost		Water Power		Steam Power		Water Power with Steam Reserve			
		60 Cycles.	25 Cycles.	60 Cycles.		60 Cycles.		25 Cycles.	
Account.	Sub-Account.	Motors and Shafting.	Motors and Shafting.	Motors and Shafting.	Engine and Shafting.	Engine and Motors Driving Shafting.	*Motors and Shafting.	Engine and Motors Driving Shafting.	Motors Driving Shafting. Reserve St'm Power throu' Frequency Changers.
		$	$	$	$	$	$	$	$
Construction	Engine	......	......	......	10000	10000	......	10000	....
	Motors Motor S.B. and Conn.	11000	11000	11000	......	11000	11000	11000	11000
	Shafting and Belting	2888	28 8	2888	3161	4328	2888	4328	2888
	Arc Dynamos Arc S.B. and Conn.	11000	11000	11000	11000	11000	11000	11000	11000
	Foundations	880	880	880	1720	1880	880	1880	880
	Total	25768	25768	25768	25881	38208	5768	38208	25768
Maintenance	Inter't and Depreciat'n	3865	3865	3865	3882	5731	3865	5731	3865
	Engine	......	......	......	200	50	......	50	......
	Motors Motor S.B. and Conn.	120	120	120	......	120	120	120	120
	Shafting and Belting	202	202	202	221	303	202	303	202
	Arc Dynamos Arc S.B. and Conn.	650	650	650	650	650	650	650	650
	Total	972	972	972	1071	1123	972	1123	972
Operating	Wages	1768	1768	1768	2253	1768	1768	1768	1768
	Supplies	462	462	462	612	462	462	462	462
	Total	2230	2230	2230	2865	2230	2230	2 30	2230
Grand Total		7067	7067	7067	7818	9084	7067	084	7067

LARGE DYNAMOS OF ABOUT 125 LIGHTS CAPACITY.

We will here consider large arc dynamos of both the 9.6 and 6.6 ampere type, as they rank about the same as regards their convenience in the station, and should it be desired to change the current of the former, they can be rewound for approximately 25 per cent. of their original cost. Owing to their compactness and cleanliness, it may not be necessary to isolate these arc machines whether engine or motor driven. About five dynamos will be required, which, if motor driven, can be connected direct, two to each motor, while if engine, or engine and motor driven, it will probably be necessary to employ shafting which, while occupying considerably more space, can likely be accommodated in the main station. If this arrangement is adopted, it is likely that the engineer on duty will be sufficient to attend to the engine which might be driving the arc dynamos, and under most conditions it will not be necessary to employ additional dynamo attendants, although the men called upon to attend the arc dynamos will have to be more intelligent than would otherwise be necessary, and owing to the increased work an extra cleaner will have to be provided. Most modern plants operating twenty-four hours per day, work their operators on eight-hour shifts, having them change shifts fortnightly, and as arc dynamos often have individual and variable peculiarities in their operation, this continual changing of operators often results in more or less deterioration in the service; this is reduced to a minimum, however, by employing a high class of operators. For the keeping of these dynamos in first-class condition, about half the time of a first-class attendant is required during the daytime, this work should always be done by the same man.

The type of arc dynamo which allows of the use of either the straight series or the multi-circuit arrangement of circuits is a decided advantage in allowing of the use of large dynamos without the necessity of increasing the E. M. F., and, to a great extent, the insulation of the circuits. It has been found, however, that the circuits have to be kept in much better repair when the multi-circuit arrangement is in use than is necessary when using small dynamos, because if any grounds, or leakage, occur between any of the circuits operated by means of the first mentioned arrangement, it has a tendency to short-circuit sections of the armature, and act on the commutator causing flashing, to an extent which very materially affects the operation, making it necessary at times to separate the circuits.

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* Paper read before the Canadian Electrical Association.

Intermittent trouble of this nature is particularly annoying, and the linemen find it very hard to locate. In one place, where considerable trouble of this nature was experienced, the cause was found to be due, to a great extent, to the use of film cut outs, having wooden mountings, enclosed in iron cases. In the place referred to, the conditions are such that it is very hard to maintain the circuits in perfect condition, and while the best of attendants are provided, and these dynamos have been in service for more than two years, to this day there is not as good service obtained from them as was obtained from the smaller machines. This is not intended as a reflection on large arc dynamos, as, of course, the remedy for the trouble above mentioned, is to look after the circuits; but very often this is not appreciated, especially if the line trouble men have been educated on the old system.

The power required where large arc dynamos are used varies from 397 to 427 H.P., and the efficiency is from 75 per cent. to 81 per cent., depending on whether direct connected sets, motors and shafting, or engines and shafting are in use.

Table No. 2 gives the approximate annual station costs when large arc dynamos are used under the different conditions mentioned. A comparison of tables numbers one and two shows a saving of only about one dollar per lamp in favor of the large dynamos, but, we must remember the saving in floor space, and that we have not yet taken into account the lamps themselves, also that there is a saving in power of about 175 H.P.

TABLE No. 2.

Showing Comparative Approximate Annual Station Costs, Using Large Arc Dynamos.

Items of Cost		Water Power		Steam Power		Water Power with Steam Reserve			
		60 Cycles	25 Cycles.	60 Cycles.		60 Cycles.		25 Cycles.	
Accounts.	Sub-Accounts	Direct Connected Sets.	Direct Connected Sets.	Direct Connected Sets.	Engine and Shafting.	DirectConnected Sets. Power A.C., G. Water or Steam.	Engine and Motors Driving Shafting.	Engine and Motors Driving Shafting.	Direct Connected Sets. Reserve Steam Power through Frequency Changers.
		$	$	$	$	$	$	$	$
Construction	Engine	......	......	......	10000	......	10000	10000	....
	Motors } Motor S.B. and Conn. }	13500	13500	13500	......	13500	11000	11000	13500
	Shafting and Belting	......	......	......	2618	......	3893	3893	....
	Arc Dynamos } Arc S.B. and Conn. }	19200	19200	19200	19200	19200	19200	19200	19200
	Foundations	400	400	400	1400	400	1510	1510	400
	TOTAL	33100	33100	33100	33218	33100	45603	45603	33100
Maintenance	Inter't and Depreciat'n	4965	4965	4965	4982	4965	6840	6840	4965
	Engine	......	......	......	200	......	50	50	....
	Motors } Motor S.B. and Conn. }	180	180	180	......	180	180	180	180
	Shafting and Belting	......	......	......	183	......	282	282	....
	Arc Dynamos } Arc S.B. and Conn. }	300	300	300	300	300	300	300	300
	TOTAL	480	480	480	683	480	812	812	480
Operation	Wages	832	832	832	1317	832	832	832	832
	Supplies	176	176	176	276	176	176	176	176
	TOTAL	1008	1008	1008	1593	1008	1008	1008	1008
GRAND TOTAL		6453	6453	6453	7258	6453	8660	8660	6453

SERIES A. C. ARC LAMP TRANSFORMERS.

It is not absolutely necessary to use transformers for the operation of series A. C. lamps, as circuits of 25 and 50 lamps after passing through regulators could be connected direct to the station busbars, the E. M. F. of which would require to be 2,000 and 4,000 volts respectively, and while this arrangement would give an increased power factor, and might give fairly good results when used in small plants having but one or two circuits, it should not be used in a plant of 500 arc lamps such as we are considering, for the reason that any defects in the arc circuits would affect the remainder of the system.

When using transformers, whether these should be arranged to supply circuits of 25, 50, 75 or 100 or more arc lamps would depend on conditions which usually have to be considered before determining the E. M. F. most suitable for use on any circuit. The higher the E. M. F., the better must be the insulation of the equipment generally, and in the event of a break down a larger number of lamps are affected. As the insulation and general lay out of the arc equipment of most of the existing plants has been arranged for circuits of about 50 lamps, and as this represents in the case of enclosed lamps an E. M. F. of 4,000 volts, an amount which, with the exception of a few minor details, is within the safety limits of the existing construction, it would seem that in adopting the A. C. system, circuits of about 50 lamps or 4,000 volts should be recommended. If circuits of 50 lamps are used, the space necessary for the installation of the transformers will be about 325 square feet. With the object of reducing the length of the circuits, some of these transformers might be located in possibly existing sub-stations, but this would result in increasing the operating expenses, and the cost of switchboards, therefore the locating of the complete arc system in the main station would most likely be advisable. The switch-board, preferably of the universal type, should be fitted with an ammeter, fuses, incandescent pilot lamp, and switch for each circuit, and if, as is likely the case, the main system is polyphase, the circuit switches should be suitable for connecting the circuits which they control to any of the different phases, this having been found a very convenient means of balancing the load on the system. A testing panel should also be part of this switch-board, being fitted with a volt, ampere, and watt meter for obtaining power factors, etc., and for checking ammeters on the circuits. This panel should have a ground detector, as well as a transformer or other suitable means of obtaining about 300 volts to be used for testing the circuits during the daytime, and for supplying current to assist in the closing of open circuits during night or day. This arrangement reduces the danger to linemen, who work with only 300 volts on the defective circuit, testing from place to place with a lamp which they use as they formerly did the wire jumper. This arrangement of testing is, of course, not possible where shunt lamps are in use as in this type the carbons remain apart. For the system of 500 lamps under consideration, eleven 50 lamp transformers should be installed, one of these being used as a spare. If suitable taps are brought out from the winding of the transformers, a variable ratio may be obtained, allowing for the number of lamps on the circuit being a few more or less than 50 without the power factor being changed to any extent.

TABLE No. 3.

Showing Comparative Approximate Annual Station Costs, Using Constant Current Transformers.

Items of Cost.		Water Power		Steam power	Water Power Using Steam Reserve.	
Account.	Sub-Account.	60 Cycles.	25 Cycles.	60 Cycles.	60 Cycles.	25 Cycles.
		$	$	$	$	$
Construction	Transformers	6600	6600	6600	6600	6600
	Switchboard	1500	1500	1500	1500	1500
	TOTAL	8100	8100	8100	8100	8100
Maintenance	Inter't and Deprec't'n	1215	1215	1215	1215	1215
	Transformers } Switchboards }	150	150	150	150	150
Operation	Wages	......	......	......	......	......
	Supplies	50	50	50	50	50
GRAND TOTAL		1415	1415	1415	1415	1415

Constant current transformers having movable primary or secondary coils are much more compact and neater than the constant potential transformers used in conjunction with an inductive regulator, and the former may have the advantage of the multi-circuit arrangement, but this necessitates double the number of circuits being brought back to the station, which is practically the same as making our circuits for 25 lamps. We might, however, use 100 lamp transformers with the multi-circuit arrangement and same floor space, but this also applies in a measure to constant potential transformers. The inductive regulator is a much more substantial piece of apparatus than the movable mechanism in a constant current transformer, and in cases of intermittent circuit trouble, when the regulating mechanism is severely taxed, the separate regulator will give the best satisfaction, and require the least attention. With the A. C. system installed in the main station, no additional attendants will be required, and the operating supplies will hardly be appreciable, while the maintenance as compared with the same capacity of revolving machinery will be very small indeed. Of course, the power for this system is obtained from revolving machines, but it is probable that it is only a portion of the full load capacity of one of a number of units employed. If a frequency of 25 cycles is being used, the operation of the A. C. arc system is made more complicated owing to frequency changers being necessary, and while these may be employed in any case in connection with all or a portion of the main system, yet they lower the efficiency and there is always the danger of interruption to the service due to the synchronous machines getting out of step from short-circuits or other causes, which objection does not exist to the same extent when induction motor driven arc dynamos are used. With A. C. transformers on a 60 cycle system, the power required will be about 347 H.P., the efficiency being 93 per cent. As in the other two systems of arc apparatus considered, a tabulated sheet (No. 3) has been made showing the comparative annual cost of this system. As it is impossible to say (except in individual cases) what proportion of the cost of frequency changers should be charged to the arc system, when 25 cycles are in use, this item has been omitted in this table, but will be considered in the cost of power later.

ARC LAMPS.

Having examined into the different arrangements of station apparatus, we now come to the lamps themselves, in the consideration of which we must pay due regard to the requirements or opinions of the customer or others depending on or using the light. Generally speaking, the systems available are the constant potential or multiple, used mainly for interior lighting, and the constant current or series, using both direct and alternating current, for street lighting. Multiple lamps are supplied for use on both alternating and direct current, but with few exceptions direct current for the operation of multiple lamps is not available in Canada, therefore multiple A. C. lamps are all that need be considered here. These are of both the open and enclosed type, but the open lamp has not met with as much favor as the latter on account of the short life of the carbons, the poor quality of the light as compared with the D. C. lamp, its unreliability, and the noise made by the arc and lamp mechanism. The multiple enclosed lamp is much superior in this respect, the power factor also being better.

Multiple lamps are used mainly to supply customers' premises where the high voltage series arc system is objectionable, or the flat-rate charged for it does not meet with approval, as the multiple lamp can be charged for by meter, and supplied from the low potential lighting system. These lamps being under control of the customer permits of his using them at any time of the day or night. This is of great advantage during dull weather, or when the lamps are used in dark buildings or in basements. Then in the case of long days or early closing, the customer is not compelled to pay for light which he does not need, as is the case when the series lamp is in use, and customers located beyond the reach of the series of commercial circuits are now as well supplied with light as those located nearer the station. The preference shown for the constant potential lamp for interior lighting is illustrated in the case of a plant which I have in mind, in which the commercial series constant current arc lamps connected are at present almost nil, where a few years ago they numbered almost 400, this, in spite of the fact that the output of the plant in all other respects has increased enormously.

TABLE No. 4.

SHOWING COMPARATIVE APPROXIMATE ANNUAL LINE COSTS FOR DIFFERENT ARC LAMPS.

Items of Cost		Open D. C. Lamps	Enclosed D. C. Lamps	Enclosed A. C. Lamps
Account	Sub-Account			
		$	$	$
Construction...	Reconstruction of Circuits.		2550	2550
	Lamps..................	10000	11500	12500
	TOTAL	10 00	14050	15050
Maintenance..	Interest and Depreciation ...	1500	2107	2257
	Lamps	1000	500	750
Operation......	Carbons	3285	700	800
	Trimming..................	3120	1040	1040
	Inspection..........	520	520	520
	Inner Globes.......... ..	....	300	350
	Outer Globes	75	125	125
	TOTAL	7000	2685	2835
GRAND TOTAL......................		9500	5292	5842

Constant current series lamps, either direct or alternating, give the best commercial satisfaction when they are of the differential rather than the shunt type. The direct current lamps are either open or enclosed. Open lamps cost about 15 per cent. less than the enclosed, and owing to the E. M. F. of the former being about 50 volts as compared to 72 volts in the latter, there is a corresponding saving in the cost of the circuit insulation, etc. The enclosed direct current lamp is much more reliable than the open lamp, the maintenance of the lamps and the outages being reduced about 50 per cent. The most noticeable saving when enclosed lamps are used is in the operation, the cost of carbons and trimming being reduced nearly two-thirds. For mechanical reasons we cannot expect a saving in line copper to correspond with the difference in current required by the two styles of lamps, as No. 6 wire will probably be required in any case; there will, however, be a slight saving in the copper losses.

The enclosed A. C. series lamp, as far as reliability of service is concerned, compares favorably with the enclosed D. C. lamp; the cost of the lamp and the maintenance is slightly more, however, as there seems to be a greater tendency for the insulation of the A. C. lamp to become punctured. This I attribute to surging, resonance, or other high voltage conditions which occur on the circuit at times of grounds, short, or open circuits, and believe that this trouble is reduced to a minimum by the use of suitable spark gaps connected across each lamp, as well as occasionally across the line. With the use of high voltage circuits, comes the necessity of installing an absolute cutout for each lamp as a protection against accidents to inspectors. Table No. 4 gives the approximate annual line costs of the three different types of series arc lamps. The costs, as stated above, are nearly equal for the two types of enclosed lamps, but the open lamp costs are nearly double that of the enclosed lamps.

ILLUMINATING QUALITIES.

The maximum candle power of the open arc is higher than that of the enclosed arc, but the light is not so steady owing to the more frequent feeding of the carbons, their poorer quality, and the action of the wind on the arc. Owing to the shortness of the open arc, and to the fact that most of the light comes from the crater of the upper carbon, this light is in a downward direction, being greatest at an angle of about 45 degrees, while a large area under the lamp is poorly lighted and affected by shadows. In the enclosed arc, the wandering of the arc is the main cause of what variation there is in the light, but by the use of an opal inner globe, these variations are greatly reduced. The increased length of the enclosed arc allows the light to diffuse in a more horizontal direction, the result being much less light in the immediate vicinity of the lamp, but a slightly increased amount midway between lamps. A comparison of the light given by the two enclosed arcs, namely, the direct current and the alternating current lamps, will show that the former gives slightly more light at all points than the alternating lamp, although the alternating lamp gives more light than the open direct current lamp midway between lamps. It is claimed that "the difference in the light (at, say, 150 feet from the lamp) between the D. C. and the A. C. enclosed lamps is nearly, if not quite, compensated for on account of the more subdued light in the vicinity of the A. C. lamp increasing the relative effect of the light at a distance by reduced contrast." Whether this is so or not,

TABLE No. 5.

SUMMARY OF ANNUAL COSTS.

STATION COSTS—INTEREST, DEPRECIATION, MAINTENANCE AND OPERATION.

Style of Station Arc Apparatus in Use	Water Power.						Steam Power				Water Power and Steam Reserve							
	60 Cycles			25 Cycles			60 Cycles.			Engine	60 Cycles				25 Cycles			
	Motors and Shafting.	Direct Connected sets.	Constant Current Transformers	Motors and Shafting.	Direct Connected Sets.	Constant Current Transformers.	Motors and Shafting.	Direct Connected Sets.	Constant Current Transformers.	Engine and Shafting	Engine and Motors Connected to Shafting.	Motors connected to Shafting.	Direct Connected Sets.	Constant Current Transformers.	Engine and Motors Connected to Shafting.	Motors Connected to Shafting.	Direct Connected Sets.	Constant Current Transformers.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Small Arc Dynamos	7067	...	...	7067	......	......	7067	......	......	7518	9084	7067	...	....	9084	7067		...
Large Arc Dynamos..	....	6453	...	.....	6453	....	.....	6453	.....	7258	8660	.....	6453	....	8660	..	6453	......
Constant Current Transformers ..	....	...	1415	.....	...	1415	.....	....	1415	...	.....	....	...	1415	....	..	.	1415

LINE COSTS—INTEREST, DEPRECIATION, MAINTENANCE AND OPERATION.

Open D.C. Lamps		Enclosed D.C. Lamps		Enclosed A.C. Lamps	
Total Cost	Cost per Lamp	Total Cost	Cost per Lamp	Total Cost	Cost per Lamp
$9500	$19	$5292	$10.6	$5842	$11.7

EFFICIENCY AND POWER FACTOR.

	Direct Connected Sets	Motors and Shafting.		Engine and Shafting.		Constant Current Transformers.
		Small Dyn.	Large Dyn.	Small Dyn.	Large Dyn.	
Efficiency....................................	81	53.8	76.8	52.7	75.25	93
Power Factor	.92	.92	.92	100	100	.75
H. P. required for 500 Lamps	397	598	420	614	427	347
Approximate H. P. required for 500 Lamps	432	650	456	614	427	[illegible]

the fact remains that the light given by the alternating lamp is apparently less than that given by the open D. C. lamp and the apparent reduction in illuminating power is a very difficult point to explain satisfactorily to the municipal authorities or the public in general. It is only fair to say though that where an old style open direct current arc system has been replaced by a modern alternating enclosed system it is rare to find any serious opposition especially so if the new system is properly handled and maintained. The possibility of such trouble need not, I think, deter anyone from installing modern equipment of this type if other conditions indicate that it is advisable to do so.

SUMMARY OF COSTS

As the factor which will determine the apparatus or system that shall be adopted, when the remodelling of an arc plant is under consideration, will most likely be the cost, it was thought that the placing of these costs in a convenient form might be useful, and this has been attempted in Table No. 5.

ASSUMED COST OF POWER.

60 Cycle Steam Power delivered on the Bus Bar—$50.00 for 24 hours service·
Steam Power delivered at Engine—$35.00 for 24 hours service.
60 Cycle Water Power delivered on the Bus Bar—$15.00 for 24 hours service.
25 Cycle Water Power delivered at 60 cycles on the B.B.—$25.00 for 24 hours service.
25 Cycle Water Power delivered at 25 cycles on the B.B.—$15.00 for 24 hours service.

1st. We have the station costs for small arc dynamos, large arc dynamos, and constant current transformers, under different operating conditions.

2nd. The line costs for open and enclosed D. C. and enclosed A. C. lamps.

3. The efficiency, power factor, horse-power, and apparent horse-power for the different types of apparatus. Also an assumed cost of power under different conditions.

From this table we should be able without much trouble to determine the approximate annual cost of a 500 arc lamp plant under almost any conditions. For example,—let us take a 60 cycle water-power plant with steam reserve, using direct connected sets and enclosed lamps. From the table we find:—

The station costs...... ....$ 6,453 00
The line costs...... .... 5,292 00

The efficiency of direct connected sets is 81 per cent. and the actual power required 397 H.P., this at an assumed figure of $15.00 per H.P. for 60 cycle water-power would equal $5,955.00, but $15.00 is for 24 hour service, so it might be fairer to charge the arc plant with but one-half of this, or $7.50 per H.P., at which the cost of our power would equal...... .... 2,977 50

The total cost would therefore be...... ....$14,722 50
Or a cost per arc lamp of about...... .... 29 44

We might now compare this cost with the cost of constant current transformers on 25 cycle water-power. For this system, we find from our table that:—

The station costs...... ....$ 1,415 00
The line costs...... .... 5,842 00

We also find that our efficiency is 93 per cent., and that the actual power required will be about 347 H.P. Our cost for power in this case will not be the same, as A. C. arc lamps will not operate on 25 cycles, so we will have to take the cost of power after it has been changed to 60 cycles, this we find is $25.00 per H.P., 347 H.P. x $12.50 (half as in the other example) would be 4,337 50

The total cost for this system being...... ....$11,594 50
Or a cost per arc lamp of...... .... 23 02

A saving in cost by the use of the A. C. system of $6.42 per lamp. When the cost of power is known to vary from those assumed in this table the change can readily have made. In most cases the cost of power would likely have to be figured on the basis of apparent horse-power rather than actual horse-power; both are found in the table.

THE ORIGIN AND DEVELOPMENT OF STORAGE BATTERIES.*

By E. B. Walker.

In 1801 Gauthert first observed that if two metals—platinum and silver—were immersed in an electrolyte and a current passed through them, a secondary current could be obtained in the opposite direction by joining the two metals by a conductor.

In 1842 Grove observed that if two gases of strong chemical affinity were connected by pieces of metal through an electrolyte, a current would pass until the two gases were exhausted. In his experiment he used two test tubes inverted over strips of platinum foil in a vessel containing dilute sulphuric acid. The two tubes contained two volumes of hydrogen and one volume of oxygen respectively. On joining the platinum strips with a wire a current passed until the gases in both tubes disappeared. On sending a current through the platinum and acid from a primary battery, the gases were formed again by electrolysis, thus storing a small supply of electricity, represented by the volumes of the gases. About 830 cubic centimeters of hydrogen at a temperature of O. degrees C. and 760 m.m. pressure, being equivalent to one ampere hour. Grove constructed a battery of fifty of these cells and managed to obtain a small arc light.

The year 1859 opens the era of the first storage battery of any practical value. Gaston Plante discovered that if a current were passed through two plates of lead immersed in dilute sulphuric acid a small current could be obtained for a short time, in the opposite direction to the charge, by joining the two plates with a conductor. This was due to the formation of lead peroxide on one of the plates, causing a difference of potential.

He also observed that by a series of charges and discharges of this nature, and by reversing the direction of the charge each time, the quantity of lead peroxide on one plate was greatly increased, while a spongy surface of pure lead was formed on the other; as this increased the capacity of his battery, he was able to construct a cell that was of some practical value. His method was to roll together two sheets of roughened lead, which were kept from touching by sticks of paraffined wood, and to immerse the whole in dilute sulphuric acid. The cell was then charged, discharged, and charged again in the opposite direction, until the plates were "formed," i.e., a coating of lead peroxide was formed on one plate and of spongy lead on the other. This process occupied a month or two, but after several experiments Plante succeeded in reducing this time considerably by soaking the plates in a bath of nitric acid, previous to the formation process.

Plante carried on his research work until 1879, but he does not appear to have succeeded in sufficiently shortening the formation period of his battery, although he is said to have made some experiments with mechanically applied active material.

FAURE SYSTEM.

As the long and tedious process of formation of the Plante element added much to the expense, it greatly checked the commercial growth of the storage battery.

In 1879, however, R. L. Metzger partially overcame this by mechanically applying to a lead plate active material in the form of a paste of lead oxide. This important improvement was not generally known, until Camille Faure obtained patents on a similar process, which is now known as the Faure system. Faure's first experiment was to cover an ordinary Plante plate with lead oxide, but he subsequently improved this by using an antimonious lead grid, with a paste of red lead, and sulphuric acid for the positive and litharge and sulphuric acid for the negative. The advantage of the antimonious lead grid over pure lead will be dealt with later.

COMPARISON OF PLANTE AND FAURE SYSTEMS.

We now have two methods of making a storage battery, both of which have striking advantages, and both, unfortunately, striking disadvantages. In the Plante system the time of formation is long and a large amount of electric power is consumed; the proportion of active material to the weight is small, as the lack of mechanical strength of the lead makes it necessary to have a thick plate to withstand any strain; the lead plate is continually undergoing a formation process from the repetition of charge and discharge, which reduces its strength. On the other hand the conductivity of the Plante plate is excellent as the active material being formed directly on the surface is always in good contact with its supporting lead plate. The active material is not likely to be jarred off or forced off by the evolution of gases; rapid discharges of heavy currents may be maintained with little or no injury to the plates.

In the Faure system the advantages and disadvantages are almost diametrically opposed to those of the Plante. The formation is quick and may be accomplished in one continuous charge. The proportion of active material to the weight is large, therefore the capacity is increased. The antimonious lead grid has greater strength, and is more rigid than the lead plate. The antimonious lead grid is only very slightly subjected to the "forming" process, and therefore retains its strength.

Here it may not be amiss to explain the term antimonious lead grid. I have used it in a general way to represent those alloys of lead, antimony, arsenic and tin, which have been made with a view to obtaining increased strength and immunity from the electrolytic effects of the current on charge and discharge. Some of these are quite successful, but the manufacturers keep the exact composition secret.

On the other hand the conductivity is lower than in the Plante, as it is difficult to maintain good contact between the active material and the grid. The expansion and contraction on charge and discharge is apt to loosen the active material and render it liable to fall out. Very heavy discharges are likely to force off the active material by forming gases inside of it.

Since this time the manufacturer has been endeavoring to produce a battery which will combine the advantages of both with none of the disadvantages. Needless to say this battery has not yet been made, but nevertheless the improvements now existing are such that the storage battery holds an important place in modern engineering practice, and it is safe to say that few, if any, of the larger direct current plants could be considered up-to-date without such an auxiliary.

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* Paper read before the Canadian Electrical Association.

To enumerate the varieties of batteries which have been patented and manufactured would occupy the remainder of the evening, but it may not be out of place to mention those which present radical improvements or entire departure from standard practice.

METHODS OF MANUFACTURE.

In order to increase the capacity per pound, many methods of increasing the active surface of the lead plate have been devised.

1. Lead plates are scored all over with a sharp tool, which raises fine leaves on the surface and increases the area, in some cases, to 17 times the superficial area.
2. Grooves are cut in a thick plate generally by sawing.
3. Plates are built up of alternate laminae of flat and corrugated lead, which are burned together at the ends.

In these three systems solid ribs are usually left at intervals in the plates, to increase the rigidity, which, however, never equals that obtained by the antimonious lead grid of the same weight.

The advantages of these systems in increasing the active surface are manifest, the drawbacks, however, are rather serious. In all three cases the chief support is pure lead, which, as was mentioned before, is subject continually to a formation process. Thus the thin leaves, ribs or laminae produced by these methods are apt to become formed right through and so break away. Too many ribs or laminae will not allow sufficient room for the formation of the lead peroxide, and buckling or forcing off some of the active material is sure to result.

Plates of this type expand and contract laterally across the surface and consequently are sure to buckle sooner or later, as it is manifestly impossible to keep this expansion and contraction the same for both sides of the plate.

The long formation process of Plante has been overcome to a great extent by the addition of lead dissolving acids or salts. The formation of peroxide or sponge lead is so hastened that the time taken is not much longer than that required for the Faure system. In some cases it has been reduced to 50 hours. Care must be taken, however, to free the plates thoroughly from such chemicals before putting them into use, as otherwise the formation process will continue until all the lead is worn away.

In these ways the Plante plate has been so improved that from a standpoint of capacity and fairly quick formation little is left to be desired, but it must be remembered that the former is only obtained by a sacrifice of mechanical strength.

These methods refer more particularly to positive plates. Negative plates for batteries of these types have been made in a similar manner, although there is not so great a necessity for strength, and consequently the number of ribs is usually less.

The Faure system has resulted in more varieties than the Plante. The chief improvements have been the shaping of the grids so as to retain more firmly the active material and the discovery of pastes which set more firmly than those originally used by Faure. Various attempts have been made to increase the porosity of the active material by the addition of powdered pumice, asbestos, etc. The exact composition of the pastes used in the leading batteries of this type are kept secret.

With all these improvements the initial disadvantages still existed, although to a less degree. The next step was to cast the grid about active material formed into pellets. In the original chloride accumulator buttons of fused lead chloride and zinc were set in operation and an antimonious lead framework cast round them under pressure. The formation process removed the chlorine and zinc, reduced the buttons of one plate to sponge lead and oxidized those of the other, to lead peroxide.

This method forms a very serviceable element with the important advantage that the strain caused by the expansion of the active material acts along lines radiating from the buttons and edgewise to the plate, consequently buckling is reduced to a minimum. This type, however, has been abandoned for a more improved pattern.

From these statements it would appear that a plate with the advantages of the antimonious lead grid for strength and non corrosibility, and of the Plante formation for durability of active material would be the most efficient combination. A few batteries of this type have been constructed, of which I shall mention two.

In one case a framework of antimonious lead is used on which are supported long narrow coils of lead ribbon, giving a large active surface with a correspondingly large capacity. As the coils are free to expand and contract little chance is left for buckling. On the other hand the lead ribbon is weakened by the continual formation of lead peroxide and consequently there is a likelihood of its being broken and the whole coil disintegrated.

The most prominent example of this class is made of a lead antimony plate cast under pressure with a series of round holes ¾-inch in diameter throughout. Into these holes is pressed corrugated lead ribbon coiled into spiral buttons.

Such a plate combines many advantages, the antimonious lead alloy cast under pressure gives the requisite strength and non-corrosibility. The lead buttons are "formed" by an improved Plante method and the expansion due to the lead peroxide wedges them so firmly in the plate that good contact is assured, the strain of expansion acts in a similar way to that described previously in the chloride plate, reducing buckling to a minimum.

The negative plates of all types present fewer difficulties. The expansion and contraction is much less, and therefore the tendency to buckle and to shed active material is diminished. One of the difficulties seems to be a tendency to form lead trees, or fine branches of lead from the negative over to the positive, thus causing a short circuit, unless the growth is removed by probing from time to time. This difficulty and the chance of plates short circuiting if they are slightly buckled has caused a great deal of experiment with different kinds of separators and envelopes to protect the plates, various forms of parchment, celluloid, pyroxylin, hard rubber, asbestos-cloth, porous earthenware, and wood have been tried; of these only two are really successful, i.e., perforated hard rubber sheets, and wood. The cost of supplying perforated hard rubber sheets for a large battery is prohibitive, and besides there is always a possibility of short circuiting through the small holes. The wood separator, however, is a decided success. Difficulty was at first experienced by the formation of acetic acid, which is a solvent of lead, but this difficulty has been removed by chemical treatment, and the wood separator is now used by the leading manufacturers.

The manufacturers of the last battery referred to have lately developed a new negative plate, which practically does away with the branching towards the positive, and also the shedding of active material.

This plate is formed of a rigid frame of antimonious lead, with square boxes covered with perforated sheets of antimonious lead; in the boxes are placed square pellets of the active material. The perforated covering so protects this that the expansion and contraction takes place altogether inside and any tendency to form lead trees is thus checked.

OTHER FCRMS.

Many novel and ingenious methods have been invented to prevent buckling and the shedding of active material. Among them is the use of earthenware grids, which support the active material and prevent it from any possibility of short-circuiting. While this is interesting from an experimental standpoint, it is of little commercial value, as the plate has low conductivity and the porous earthenware greatly increases the internal resistance of the cell. Another form is a battery built up of trays laid horizontally, one on top of the other, the active material is held by the trays and the whole forms a battery, somewhat like the voltaic pile. The high internal resistance and the difficulty of keeping the trays properly insulated makes this of little practical use.

Various experiments have been tried with active material without any grid. The material itself is a poor conductor, and on this account graphite has been mixed with it, and the whole compressed into flat plates on a framework of thin sheet lead, used solely to obtain good contact. In a prominent example the active material was formed of litharge and ammonium sulphate pressed into a flat plate. By various chemical processes this plate was formed into lead peroxide and hardened. A framework of lead was used to support it and to give the necessary contact, making the whole look like a school slate. The capacity was very high, being about 10 ampere hours per pound.

These methods, however, while interesting from an experimental standpoint, are also of very little use, as the active material rapidly disintegrates.

Several batteries have been constructed, in which two different metals are used for the plates. The most notable of these are the lead-zinc battery and Edison's nickel-iron battery.

There is one inherent drawback in all batteries in which two different metals are used, and that is the probability of small particles of one of the metals being carried across to the other, thus forming a local cell. In the lead battery if a small particle of one plate were to be deposited on the other, a local cell would be formed, but action would only take place until the foreign particle was converted into the same material as the plate. This, of course, could never take place in a cell using two different metals.

As regards Edison's battery, very little reliable information can be obtained on certain points. However, most of those who have made tests seem to be agreed. Recent tests made in London show the ampere-hours per pound to is undoubtedly higher than in the lead battery, the average voltage per cell is about 1.2 as against 1.95 in the lead battery. This makes it necessary to use about 70 cells of Edison's battery against 44 cells of lead battery, making a proportion of 5 to 7 in weight for the same watt-hour capacity, in favor of the lead battery. The internal resistance is high, causing bad regulation. The efficiency has been rated as low as 60 per cent., whereas the lead battery is rated from 75 per cent. up. The chief point urged by its advocates is durability; of this quality, however, we have no authentic proof. The writer heard, not long ago, that Mr. Edison had withdrawn his battery from the market, as he is not yet satisfied with it.

In the lead-zinc battery a peroxide plate is used for the positive, and a pure zinc plate for the negative. The advantages are higher voltage (about 2.5 per cell) and about 57 per cent. more capacity per pound in watt-hours. The drawbacks are the difficulties in redepositing the zinc, and in preventing small particles of it from being deposited on the peroxide plate, thus causing local action.

Notwithstanding the numerous varieties of storage batteries which have been produced, we are still limited to the Plante and Faure systems for all commercial work. Each has found its place and to-day the Plante system is almost universally used for stationary work, and the Faure for vehicle work.

There is one particular feature about the Plante battery which renders it especially superior to the Faure type for heavy discharges of short duration, such as are required in the regulation of railway loads, and this is that the capacity of the Plante battery at the one hour rate is 55 per cent. of its capacity at the 8 hour rate, while that of the Faure is only 46 per cent. Among the prominent types of batteries used to-day, the Plante for stationary work has a capacity of about 2.3 to 4.1 ampere-hours per pound of element, and the Faure for vehicle work about 4.8 to 5.6. The Plante negative is little used, as the advantages of this system which appear in the positive are not manifest in the negative. A good negative will often outlast two sets of positive plates.

DISEASES AND THEIR REMEDIES.

(1) Shedding of active material and loss of capacity.
(2) Corrosion of plates.
(3) Buckling.
(4) Sulphatation.
(5) Formation of lead growths from negative to positive.

1. Shedding of active material and consequent loss of capacity is caused by too rapid discharges, forming gases which force out the active material. Loss of capacity is further caused by the formation of excessive lead sulphate, which often clogs the pores of the lead sponge and forms a layer between the grid and the active material. The shedding of active material is also due to the following causes :

(1) Imperfect application of paste.
(2) Overcrowding of active material in the formation of Plante plates.
(3) Discharging at too high rates.

2. Corrosion of plates is caused chiefly by the presence of lead dissolving chemicals in the electrolyte; on this account it is advisable, in replacing loss by evaporation, to use distilled water, unless very pure water is otherwise obtainable.

3. Buckling is due to heavy rates of discharge, which cause unequal expansion. It can also occur at low rates, if the active material is unequally applied.

4. Sulphatation; an excess of lead sulphate is formed when a battery is over discharged. It can be removed by overcharging at a low rate, but if allowed to remain long after formation it hardens, and on account of its low conductivity cannot be reduced by its recharging.

5. The formation of lead trees, which we have already mentioned, has been overcome by the use of the box negative and wood separators previously referred to.

APPLICATIONS.

There are many more uses of the storage battery than would occur to the layman. The simplest and most apparent application is "straight" storage work, as used in connection with automobiles. The efficiency of this method is not very high, about 75 per cent. being a fair average. However, by intelligent handling much higher efficiency may be obtained, 85 per cent. being about the maximum.

The next example of "straight" storage work is the use of batteries for supplying lights at night, after the generators are shut down. This necessitates some method of controlling the voltage of the battery, which will drop from 2.1 volts per cell at the beginning of discharge to 1.75 at the end, with an average of 1.92 to 1.95. The three standard methods of regulating this discharge voltage are (1) resistance, (2) end cells, (3) counter E.M.F. cells. The resistance method is the simplest, but it is very unsatisfactory except when lights are burned continually, as every time a light is turned on or off the rheostat handle must be adjusted.

End cells are the most efficient method by far, for on 110 volt circuit 52 cells will be needed at the beginning of the discharge, and 63 or 64 cells at the end. These extra cells are cut in and out by means of an end cell switch. During the greater part of discharge 56 or 57 cells will be in use, the remainder only coming into service at the end, and thus they are only slightly discharged.

There is one drawback in the end cell system, and it is that the different cells require different amounts of charge, necessitating great care on the part of the attendant to prevent overcharging. On this account the counter E.M.F. cell is preferable in small plants, where efficiency is of less importance and where skilled attention is more difficult to obtain.

These counter E.M.F. cells are blank grids without active material, immersed in dilute sulphuric acid, and they offer an opposing E.M.F. to the passage of the current of 2.3 to 2.5 volts per cell. The system is no more efficient than the resistance, but the fact that the potential difference of the counter E.M.F. cell only varies between 2.3 and 2.5 volts from any load from one lamp to full load, makes the voltage regulation almost equal to that of the end cell.

Another feature of storage batteries for work of this kind is the necessity of higher charging voltage than the 'bus pressure. The maximum is 2.5 per cell, making a total of 160 volts for an 110 volt battery. Thus extra pressure must be obtained to the extent of 50 volts.

There are three standard ways of accomplishing this, one by cutting the battery into halves and charging in parallel, thus making the total necessary voltage 80, the remaining voltage is cut down through resistance. This of course is very inefficient but is suitable for small plants where it would be too expensive to install a booster.

The second method is to use a specially wound generator of 160 volts maximum, which will operate successfully at 110 volts. The voltage is raised as the charge proceeds and the discharge voltage controlled by Counter E.M.F. cells or by tapping off the battery at the necessary point by means of an end cell switch.

The third method is to use a small shunt generator of 50 volts capacity, termed a booster, connected in series with the battery and 'bus.

REGULATING BATTERIES.

Storage batteries are now very generally used in regulating the rapid fluctuations in railway and other power circuits. Here the battery charges and discharges with fluctuations in the station load and consequently does not have time to reach the higher portion of the charging voltage curve, nor the lower portion of the discharge curve, thus raising the efficiency of the battery as high as 92 to 95 per cent. For work of this nature the battery will require a line voltage which fluctuates more than the battery voltage, or some means of regulating the latter so that the battery may take its share of the load automatically. A highly fluctuating voltage is not usually permissible except out on a long railway feeder where it cannot be helped. A battery installed at such a point will reduce the fluctuations in voltage and by supplying a source of power at the point of application will lessen the copper drop, as loads between it and the power house will be fed both ways.

Where constant potential is required as when a battery is installed at the power house, a booster with a compounded field or some other regulating device is necessary to regulate the battery voltage.

Many different devices have been patented in the way of regulating boosters. Most of them consist of some system of a series field opposing a shunt field by which the fluctuations of the external load are made to regulate the booster voltage, so that the battery will discharge and charge automatically with the rise and fall of the external load above and below the average, keeping the generator load constant.

It would occupy too much space to give a detailed description of the various styles of boosters, and for the same reason I have not alluded to many of the interesting characteristics of storage batteries.

THE CURTIS STEAM TURBINE.*

BY FRANK C. SMALLPIECE.

With the development of the steam turbine we are entering upon a new epoch in the history of steam engineering, and it would seem that the reciprocating engine, the product of the engineering skill of two centuries is soon to give place to the simpler and more efficient prime mover. Both in its application to marine propulsion and in the electrical field the success of the turbine is already established. In England the capacity of steam turbines in operation aggregates upwards of 250,000 H.P., while on this continent one manufacturing concern alone has orders for some 350,000 H.P. in steam turbines for electrical purposes. This is a remarkable showing when we consider that the introduction of the turbine as a commercial machine has taken place practically within the past five years.

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* Paper read before the Canadian Electrical Association.

As a matter of history it is interesting to note that the first steam engines of which we have any record were of the turbine type. However in the development of the reciprocating engine following the days of Watt the turbine was neglected, and it is only within the past twenty years that its possibilities have been investigated. In 1885 a 10 H.P. steam turbine built according to the ideas of the Hon. Chas. Parsons gave such promise of success as to encourage further work in this field, and as a result, some seven years later, in the tests of a 100 K.W. Parsons' turbo generator set, an efficiency was obtained which compared favorably with the records of compound condensing engines of that date. About this time De Laval, a Swedish Engineer, brought out a steam turbine which, though differing widely from the Parsons' turbine in construction, showed very fair economy. Credit is due these two men for their early work in the turbine field.

On this continent the introduction of the steam turbine is of comparatively recent date. In 1896 the Westinghouse Machine Company acquired the rights to manufacture the Parsons' turbine. A number of turbo-generator units of the type ranging in capacity from 300 to 2,500 K.W. have been built and several sets of 5000 K.W. capacity are nearing completion. It is stated that there are in the field, and in course of construction Westinghouse steam turbines of about 110,000 capacity. Turbines of the De Laval type have also been built for some years in sizes ranging from 1½ H.P. to 300 H.P., and the aggregate capacity in operation up to the end of 1902 is given as 5,400 H.P. It should be stated that the use of gearing which is necessary to reduce the speed of this type of turbine, limits its application to small sizes, and is objectionable, occupying as it does, considerably greater space than the turbine itself.

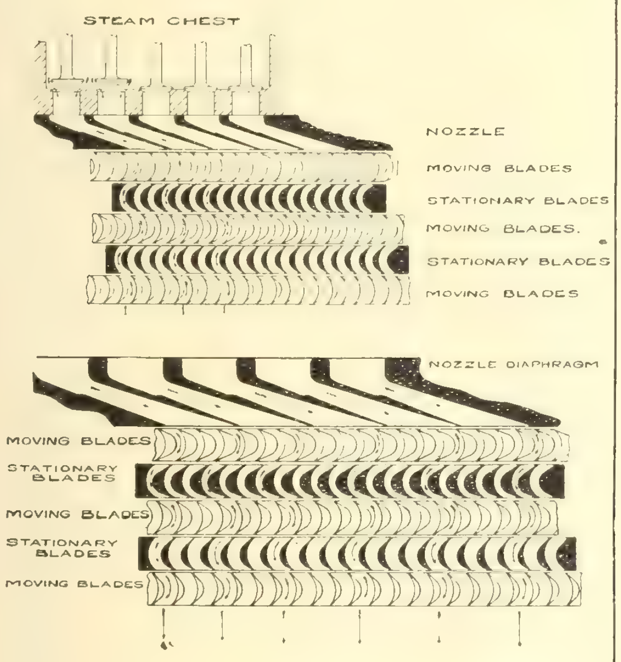


DIAGRAM OF NOZZLES & BUCKETS IN CURTIS STEAM TURBINE.

FIG 1

In April 1903 the first announcement was made regarding the Curtis Steam Turbine, which is the subject of this paper. The design of this turbine is based upon the ideas of Mr. Chas. G. Curtis, of New York, which are the subject of patents granted in 1896. Subsequently, machines of this type were built and tested at the Schenectady Works of the General Electric Co. The results of these extended investigations were so favorable that arrangements were made for the manufacture of the turbine.

Before undertaking commercial production, however, considerable time was spent in further development under the direction of Mr. W. L. R. Emmet of the General Electric Company. A number of features of the present machine were added during this period, the most important being the adoption of the vertical type of machine. This was a radical departure and required considerable courage on the part of the designers. This type of turbine presents many advantages in simplicity of construction and operation, besides affording great economy in floor space. Experience has demonstrated the reliability of the vertical turbine and all turbo-generator sets of 500 K.W. and upwards are now constructed in this form.

About a year ago the first Curtis Turbine set built by the General Electric Co. for use outside its factories was put into operation at Newport R.I. Since its installation, two other similar machines have been placed in the same station. Complete tests on one of these sets are given in the latter part of this paper. These turbines have carried the whole load of the station without interruption since installation. In Chicago, there have been installed three 5000 K.W. units, two of which have been in regular service for some months. At the present time there are in regular operation Curtis Turbines, aggregating 32,000 K.W. capacity in 28 units of 500 K.W. and upwards.

The action of the steam turbine involves the conversion of the heat energy of the steam into velocity by expansion. This rapidly moving steam is directed into buckets or vanes arranged upon the periphery of the revolving element where the kinetic energy of its particles is given up by impact. In its elementary form the steam turbine consists of one or more steam jets impinging upon the vanes of a single wheel. The spouting velocity of steam is so enormous, however, that for most efficient action such an arrangement requires a wheel velocity much in excess of the safe working limit of the best materials. Further, unless a wheel of excessive diameter be employed it is necessary to use gearing to reduce the speed for practical purposes. For this reason the efforts of inventors have been directed towards the design of a turbine which shall combine high efficiency with a speed permitting direct connection for electrical or marine purposes. In all turbines the expansion which takes place is so rapid that it necessarily follows the adiabatic line. The steam is directed upon the revolving buckets, either through stationary vanes, similar to the revolving buckets in form, but reversed in curvature, or by expanding nozzles which efficiently convert the energy of the expanding steam into velocity. In the latter case the conversion of the inherent energy of the steam into kinetic energy is carried out in the nozzle to any desired limit.

Referring to Fig. 1 we have a sectional view of the expanding nozzle such as is used in the Curtis Steam Turbine. Steam is admitted from the space above and converges towards the narrowest section known as the throat. At this point its pressure has fallen to .58 of the initial pressure and a corresponding portion of the heat energy of the steam has become active in expansion, thus performing work upon itself in giving velocity to its own particles. Beyond the throat, if it is desired to increase the velocity still further, the same energy transformation continues. To allow for further expansion, however, it is necessary to increase the cross sectional area of the nozzle. This is evident when we consider that the work done by the expanding steam varies approximately in direct proportion to the number of expansions and also as the square of the velocity. Hence the volume of the steam increases much more rapidly than the velocity, and it is necessary to provide for this increased velocity by enlarging the section of the stream.

It is difficult to appreciate the completeness of this energy transformation. Assume the case of a nozzle used to expand steam from 150 lbs. guage pressure to an absolute pressure of 2 inches of mercury, or 28 inches vacuum. Entering the nozzle the steam is at 150 lbs. pressure, and its energy exists in the potential form. At exit from the nozzle a few inches distant, the pressure has fallen to 28 inches vacuum, and the specific volume of the steam has increased some 125 fold. The same energy (neglecting slight friction losses) exists in the particles of steam which issue from the nozzle at about 4,000 feet per second. The energy of a moving body being proportional to the square of its velocity, one pound of steam under these conditions represents 250,000 foot lbs. of energy.

A brief description of the leading commercial types of turbines may be of interest in showing the different methods employed to secure low speed of rotation.

The De Laval turbine is of the single wheel type and is subject to the limitations already mentioned as to size. The gearing employed to reduce the speed is spirally cut, and ten to one in ratio. To permit free rotation of the wheel about its centre of gravity, a light flexible shaft is employed. Steam is supplied through one or more individual expanding nozzles, and governing is effected by throttling, which involves a decrease in efficiency. The number of nozzles in use is varied by hand to suit the load.

In the Parsons' Turbine the rotating element is a cylinder the diameter of which is increased by one or more steps from the admission to the exhaust end, to allow for the expansion of the steam. This cylinder carries on its periphery, successive rows of buckets. The first rows are exceedingly small both in radial and transverse dimensions progressively increasing in height as the exhaust end of the turbine is approached. Enclosing this rotating element is the casing, which is of a diameter slightly greater than the height of the moving buckets, and which carries on its inner walls similar rows of buckets which alternate with those on the revolving cylinder. The steam is admitted all round the circumference and carried in an axial direction through the annular space between the two cylinders. The expansion is continuous from admission to exhaust. In this way the steam never acquires a velocity approaching the speed which it attains in an expanding nozzle, but instead moves along, alternately acquiring velocity by expansion and giving it up by impact with the moving vanes. As many as 50,000 vanes are frequently required in a single turbine.

Steam is admitted to the turbine in puffs of constant frequency, but of long or short duration according to the load. The fraction of one period during which steam is admitted is controlled by the governor, acting through a relay mechanism. It is claimed that throttling does not take place even at light loads.

To eliminate vibration, concentric bearings are employed, consisting of several bronze sleeves, with small clearances between them. Oil is supplied to these sleeves under pressure, and lateral freedom is thus given to the journal. It is evident from a consideration of the action of the steam in this turbine that there will be a heavy end thrust. It is necessary to compensate for this thrust by employing several pistons, forming a part of the revolving drum. Steam is admitted between these pistons and thus tends to balance the thrust.

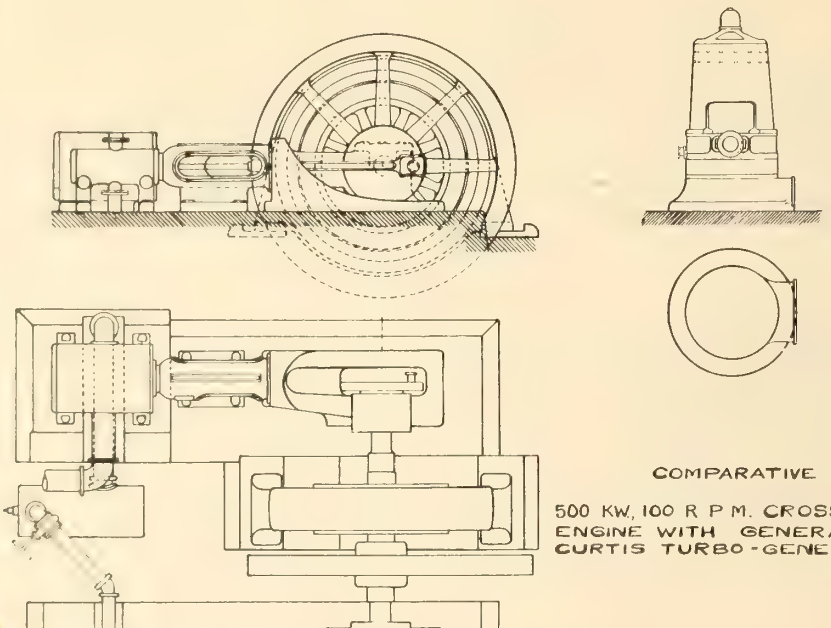
In Europe considerable interest has been aroused in the Rateau Turbine. It is essentially a multi-stage turbine of the jet or impact type. In other words the combination of a set of nozzles directing steam into a single wheel is repeated through some twenty or thirty adjoining chambers. All wheels are mounted upon the same shaft, and the casing is divided into compartments by diaphragms, which carry the nozzles. The wheels are of very light construction, tapering in cross section from the centre to the circumference. The nozzles, or distributors, as they are called, increase in size and in number progressively as the exhaust end of the turbine is approached. As in the Parsons' Turbine the last stages of the expansion are carried out through bucket rings of larger diameter in order to allow for the rapid increase in the volume of the steam under very low pressures.

Still another form of European Turbine is the Reidler-Stumpf which has been brought into prominence within the last year by Professors Reidler and Stumpf of Charlottenburg. Unlike other turbines described the steam is not directed upon the wheel at an angle to the plane of rotation, but instead strikes squarely upon the face of the buckets. These buckets are usually of a double pattern similar to the buckets of a Pelton wheel, except that in this case the bucket is milled obliquely like the pocket in the face of the nickel steel ring. The wheel is of large diameter, and in this way a comparatively low rotative speed is obtained. Frequently fractional abstraction of the velocity is obtained by milling the pockets side by side of unequal size. In such cases steam from the nozzles impinges upon the inner edge of the smaller buckets, sweeps around the semicircle of these pockets and flows into a tube guide. Through this guide the steam is led in a semicircle without loss of energy except through friction, and is directed upon the wheel again, this time impinging upon the larger set of pockets. Losses due to cross currents and spraying in the passage through the intermediate guide tube are minimized by dividing the tube into narrow passages. The steam is usually carried forward in this tube so that the second point of contact with the wheel is in advance of the first. A four stage arrangement has been designed having four wheels constructed as above, attached to a single shaft but running in separate compartments.

The great advantage of the Curtis Steam Turbine, as compared with other types, is the low speed of rotation which it is possible to obtain without sacrifice of efficiency. In its present construction the expansion takes place in several stages or separate compartments, each stage being furnished on the admission side with suitable nozzles which direct the steam into the bucket wheels in that stage. In each stage are arranged bucket wheels carrying two or more rows of buckets, while between successive rows of moving buckets are the intermediates or stationary buckets reversed in direction. The steam from the nozzle strikes the first row of moving buckets, giving up some of its energy, shown in loss of velocity. Leaving the moving buckets, the steam is guided through the stationary vanes and impinges upon the second row of moving buckets, giving up another portion of its energy. Should there be more than two rows of buckets the same course is followed, rebounding from stationary to moving buckets, until almost brought to rest on leaving the last wheel. This process is known as fractional abstraction, and in this way high velocity steam is made to efficiently impart motion to a comparatively slowly moving element.

The arrangement of nozzles in the Curtis Turbine is clearly shown in Fig. No. 1. Instead of a number of separate streams, the flow is directed in a belt upon the buckets. The nozzles occupy only a small part of the circumference in the first stage, the breadth of the steam belt increasing in succeeding stages. In the last stage, where the volume of steam is very large, steam is generally admitted all round the wheels. As the steam admitted to the turbine is directed upon only a portion of the circumference, it is possible to obtain any desired speed of rotation within wide limits by using a wheel of suitable diameter. This is an advantage not presented by turbines in which steam is admitted all round the wheels.

Governing is accomplished without loss of pressure by throttling. The admission of steam to the sections of the first stage nozzles is controlled by separate valves, which

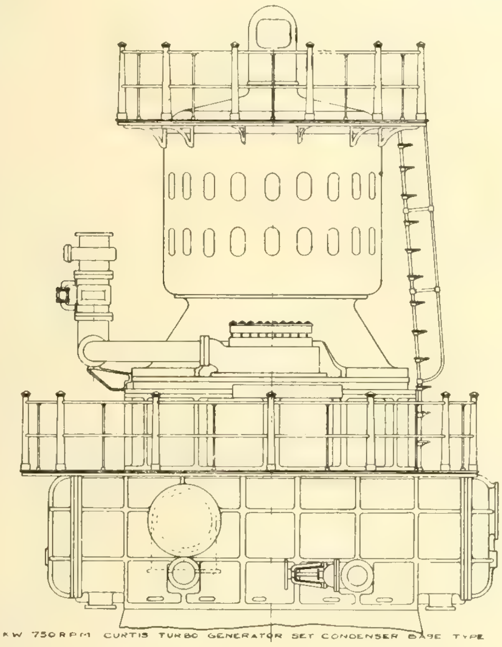


COMPARATIVE VIEW

500 KW, 100 R.P.M. CROSS COMPOUND CORLISS ENGINE WITH GENERATOR & 500, 1800 R.P.M. CURTIS TURBO-GENERATOR UNIT.

FIG. 2.

operate consecutively. With a change of load the breadth of the active steam belt is varied automatically by the closing of one or more of the end sections. In this way the supply of steam is not dependent upon action of a single valve, and a failure of one of the sectional valves only serves to throw the work upon the next in order. In some of the first machines, this sectional governing was carried out simultaneously in all stages. However, as the economy is not materially improved by this arrangement, it is not employed. Hand operated valves, opening additional nozzles, are sometimes employed in the later stages.



2000 K W 750 R P M CURTIS TURBO GENERATOR SET CONDENSER BASE TYPE

FIG 3

These are set to give the best possible conditions under the average of load of the machine, but are not adjusted for fluctuations of short duration. For overload conditions automatic valves are occasionally used to limit the rise of pressure by opening additional nozzle sections in the next lower stage.

The governor itself is of the centrifugal type and is attached to the top of the generator shaft. The motion of the governer, by electrical or mechanical means, is made to operate small pilot valves, which in turn admit or exhaust live steam from the spaces behind the governing valves. In the case of electrically operated valves the governor actuates the fingers of a small controller, opening or closing the circuits of electro magnets, which in turn operate the pilot valves. The current for these magnets is taken from the exciter bus-bars, and the arrangement is such that, in case of failure of the current supply, the governing valves close, avoiding the possibility of a dangerous increase in speed. When the electrical control is not employed the pilot valves are actuated directly from a suitable cam cylinder, which is turned by the governor. For synchronizing purposes a device is used in conjunction with the governor whereby the speed of the turbine can be varied considerably while the machine is in operation. In large machines this synchronizing device is operated by a small motor, controlled from the switchboard.

As an additional safe-guard against possible racing of the turbine, simple emergency tripping devices are arranged which act at a speed somewhat in excess of normal, and close a butterfly valve in the main steam pipe. At the same time a valve in the lower part of the machine is operated and breaks the vacuum.

A distinctive feature of the Curtis Turbine, as compared with other types, is its vertical form. The saving in weight and floor space is very considerable, the weight being from 15 to 25 per cent. and the floor space less than 10 per cent. that of a slow speed engine generator set of the same capacity. Figure No. 2 shows a comparative view of a 500 K.W. 100 R.P.M. Hamilton Corliss Cross Compound Engine with generator and a 500 K.W. 1800 R.P.M. Curtis Turbo Generator unit. The engine unit occupies 750 square feet and weighs 277,000 lbs. as compared with 50 square feet and 38,000 lbs. for the turbine set. The adoption of the vertical form of machine called forth considerable criticism, but the satisfactory results obtained have even exceeded the expectation of the designers. The step bearing consists of two cast iron plates, one of which is keyed to the foot of the shaft, the lower plate being stationary. Oil under pressure enters a central recess in the faces of the plates and is forced outward to the circumference. Thus the whole weight of the moving element is carried upon a thin film of oil. The upper bearings serve only as guides for the shaft, and are not subjected to any load. The mechanical friction of this arrangement is almost nil. With the vertical type of machine there are none of the difficulties in vibration met with in the supporting of a heavy rotating element between horizontal bearings at a considerable distance apart. There is less tendency of the shaft to spring and cause rubbing, and as the whole weight is carried by the step bearing, the diameter of the shaft need not be reduced at the journals but may be made as large as desired. The compact arrangement of the wheels and casing makes the expansion very small, and furthermore, all expansion is upward and does not produce the distortion encountered in horizontal machines.

In a station comprising a number of vertical units the oil is supplied from one or two steam driven pumps, and as a precaution against failure, a dead weight accumulator may be employed, capable of supplying high pressure oil for a limited period. The worst that can happen in case of failure of the oil pressure is a grinding of the step bearing plates. These can either be faced off or easily and cheaply replaced by new blocks. When the forced supply of lubricant to a horizontal machine fails, it usually results in cutting the shaft as well as the bearing.

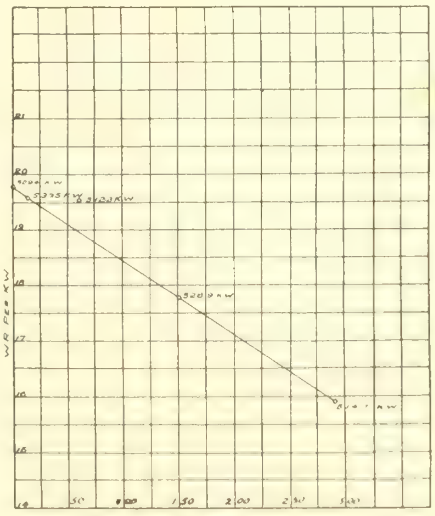
It is of interest to note that in the Curtis Turbine there is no end thrust due to the action of the steam on the buckets. The angles of entrance and of exit being the same in a moving bucket, the components of the force, exerted in a direction parallel to the shaft, are equal and opposite in sign. The pressure of the medium in any stage is the same at all points. The absence of end thrust is demonstrated in that there is no rise in the oil pressure on the step bearing of the machine when steam is turned on.

A very high degree of expansion is desirable, though not essential, for favorable results in the Curtis Turbine. Owing to the compact arrangement of the casing, the chances of air leakage are extremely small, and a high vacuum is easily maintained where a liberal supply of condensing water is available.

In general the surface condenser is preferable for use with steam turbines. This type permits a higher vacuum and also allows the return of the condensed steam to the boiler. No oil comes in contact with the steam during its passage through the turbine. Consequently, the exhaust steam is free from impurities.

When the amount of cooling water is limited, the jet condenser may be found advisable, but the vacuum attainable with this type of condenser is not so good on account of the presence of entrained air in the injection water.

As to whether the somewhat higher initial cost warrants the installation of surface condensers is a matter to be decided by local conditions. The price of coal, the load factor, temperature and quantity of cooling water available, and other considerations may make it advisable to provide for a 27 inch or even a 26 inch vacuum in place of a 28 inch vacuum or higher. Nevertheless, in most cases the gain in economy, due to high vacuum, warrants the expense entailed. Accordingly, stations equipped with Curtis Turbines are almost without exception provided with condensing plants to secure a vacuum of at least 28 inches.



Machines known as the Condenser Base Turbines form a new type. Several of these are under construction, the condenser being contained in the turbine base. The simplicity of this arrangement, the short direct path of the steam to the condenser, and the saving in floor space are at once evident. Figure No. 3 shows a 2000 K.W. set of this type.

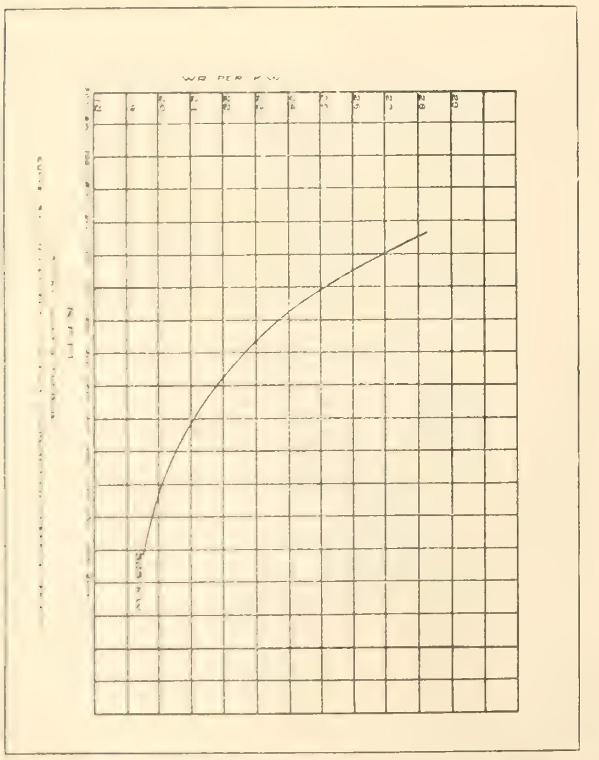
The losses due to friction and windage in the Curtis Turbine remain in the form of heat, and are thus largely useful in re-evaporating the water of expansion. Drier steam is in this way supplied to the next stage. Unlike the reciprocating engine, the accidental carrying over of water from the boilers produces no ill effects in the turbine.

Superheated steam up to any temperature commercially available, may be used in the standard Curtis Turbines, the design of the apparatus allowing either dry or superheated steam to be used at will.

A limited series of tests indicates that in the Curtis Turbine the use of superheat decreases the steam consumption at the rate of about 1 per cent. for every 14 degrees F. Similar considerations as affect the choice of vacuum apply largely in the case of superheaters. The initial cost and maintenance, and cost of fuel have to be considered. Recent experiments indicate that at high temperatures the specific heat of superheated steam at constant pressure is considerably in excess of the value heretofore assumed (viz. .48). Hence the reduction in water rate due to highly superheated steam may be gained at the expense of too much fuel. However, as a general rule a moderate amount of superheat is advisable.

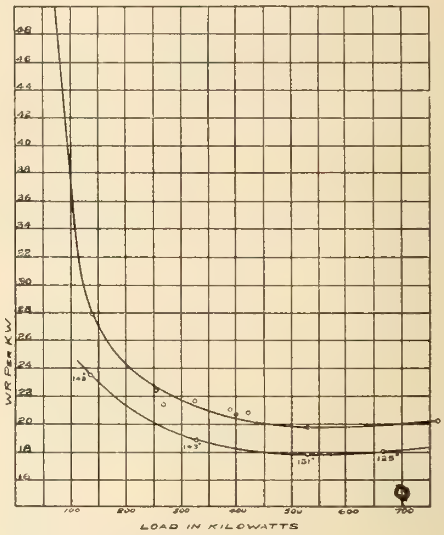
It will be readily understood that the problem of generator design for steam turbines involves a great many features not encountered heretofore. The construction of the revolving element must be of great strength and rigidity. All parts must be balanced separately with the greatest care. In the case of revolving field machines, the field core is built up of steel plates rivetted together in sections of one-half to one inch thick, depending on the size. Each of these sections must be balanced accurately before assembling. The edgewise wound field coils are subjected to heavy pressure in baking, and are arranged so that shifting on the poles is impossible. The assembled field is given a balance under running conditions. This is done after the turbine is set up by the addition of suitable weights. Similar methods are employed in the balancing of direct current armatures, the commutator, armature heads, etc., being all balanced separately and the punchings balanced in sections.

Data regarding the performance of Curtis Turbines has up to the present been largely confined to results obtained in the factory, and few opportunities for official tests have been presented. The tests given below were made upon a [illegible] K.W. [illegible] Cycle, 2300 V. set, operating at about 1800 R.P.M. and installed in the Newport Station of the Massachusetts Electric Company. Current from this station is supplied for railway and lighting, the railway work being the most important part of the load. The tests were conducted by Mr. George H. Barrus, Consulting Engineer, representing the owners, and Messrs. R. H. Rice, recently of Rice, Sargent & Company, and A. R. Dodge, acting for the General Electric Company.



Tests were made and water rates measured with various conditions of fixed load, with and without superheat, as shown by the curves and tables. Tests were also made with such commercial loads as are daily experienced in this plant, and the steam consumption per kilowatt hour under working conditions was ascertained by careful determinations of the total water condensed, and of the load as measured by many instruments and as recorded by carefully checked recording wattmeters.

Attention is specially called to the records of operation under commercial load, since they illustrate the great practical advantage afforded by apparatus of this kind. The load during these tests fluctuated incessantly with an average sudden variation of about 100 kilowatts, and with an average load of 253 kilowatts in one case and 421 kilowatts in another. In the former case the average steam consumption per kilowatt hour was only 22.38 lbs. The best steam engines now used for such purposes in this country would consume at least 28 pounds of steam per kilowatt hour under such load conditions, and in most cases the consumption would be considerably larger. The consumption of 20.73 pounds per kilowatt hour with an average of 421 kilowatts for such variable load is also a very fine performance. During tests the steam pressure was about 145 pounds and the vacuum about 95 per cent. The speed regulation from no load to full load was 8-10 of 1 per cent. Momentum speed variations at full load did not exceed 1.6 per cent. and under the commercial load of the station showed a maximum of 2.1 per cent.



600 K W CURTIS TURBINE
CURVE SHOWING STEAM CONSUMPTION (WATER RATE PER K W)
AT DIFFERENT LOADS

The liberal design of the generator is shown in the temperatures. After a run of eight hours at 660 K.W., the highest temperature rise was 38 degrees C., and with a load of 764 K.W., or 53 per cent. overload for two hours no further increase in temperature was noted.

In considering these practical results it should be borne in mind that the plant which gives these results possesses many other practical advantages which conduce to economy. All the condensed water in this plant since it originally started has been returned directly to the boilers, and the boilers are consequently at the present time in a perfectly clean condition, although the natural water supply of Newport is bad. During all this time no oil has passed into the boilers nor has any been wasted. All the oil in use is simply circulated and used over and over again. The absence of air leakage in the turbine and the absence of air in the feed water greatly simpfify the maintenance of good vacuum, which, of course, contributes to these excellent practical results. The whole arrangement of this plant is compact, simple and easy of maintenance, and the results are representative of those which can be obtained anywhere from such apparatus where the water for condensation is available.

SUMMARY OF COMMERCIAL RUNS.

	Jan. 15, 1904.	Jan. 26, 1904.
Duration	12 hours.	15 hours.
Total coal wet	13,517 lbs.	10,205 lbs.
Moisture in coal	3.1 per cent.	5.5 per cent.
Water evaporated	127,267 lbs.	104,026 lbs.
Drip withdrawn from steam pipe per hour	——.	46 lbs.
Moisture by calorimeter	3.05 per cent.	2.1 per cent.
Total steam to turbine	108,100 lbs.	86,833 lbs
Steam per hour to turbine	9,008.6 lbs.	5,789 lbs.
Dry steam per hour to turbine	8,733.8 lbs.	5,667 lbs

Load by Polyphase meter	406.4 kw.	234.7 kw.
Load on auxiliaries (average).......	14.9 kw.	18.5 kw.
Total load average	4[illegible].3 kw.	253.2 kw.
Dry steam per kilowatt hour.........	20.73 lbs.	22.38 lbs.
Dry coal per kilowatt hour	2.67 lbs.	2.54 lbs.

Load....................	1½	Full	¾	½	¼
Dry steam per kilowatt hour, lbs.	20.22	19.78	20.69	21.38	27.85

The above results were obtained on the first commercial machine, and changes have since been made which greatly improve the economy. From incomplete tests upon a new 2000 K.W. set, it would seem that the results obtained on the first machine can be improved by at least 15 per cent. Complete figures on these tests are not available at present.

HEAVY ELECTRIC TRACTION BY ALTERNATING CURRENTS.*

By P. M. Lincoln.

Again and again the prophecy has been made that the steam locomotive is doomed to extinction—that electricity will take the place of the steam locomotive in through service on trunk lines just as it has replaced the horse as a motive power for local service on urban and suburban lines. The displacement of the horse as a motive power has been complete. Not only that, but the field previously occupied by the horse has been broadened and extended until the service rendered has approached both in weight of vehicles, speed and distance travelled, the service rendered by steam trunk lines. In view of the extremely rapid growth of electric traction in extent as well as in weights of the cars and speeds, the prophecy that the steam locomotive is about to pass is not a surprising one.

With this prediction in mind, therefore, the writer recently undertook to look up the records of one of the large electric manufacturing companies to find the extent in which electricity has been substituted for steam. The writer had in mind such well-known examples as the equipment of the B. & O. tunnel in Baltimore, the New York elevated lines and the proposed electrification of Pennsylvania and New York Central systems in and around New York. Recalling these he expected to find many typical examples where electricity had displaced steam for various kinds of traffic. It was surprising to find, therefore, that the examples above mentioned are practically the only ones where such substitution has been made or actively undertaken in this country. There are a number of examples where the service rendered by electricity is comparable in many respects to that rendered on trunk lines, but such service almost invariably has been due to the expansion of an urban or suburban electric system, and does not indicate any tendency on the part of the trunk line managers to adopt electricity as a motive power. Even in the cases cited above where electricity has been substituted for steam, the change from steam to electricity can hardly be said to have been made voluntarily. The New York Central decided to make the change only after an appalling accident due to the obscuring of signals by the smoke of locomotives. In the case of the Pennsylvania Railroad the use of long tunnels which would be fouled by locomotive smoke and gases, certainly beyond the point of comfort for passengers and possibly beyond the point of endurance, practically forced the adoption of electricity. The class of service represented by the Manhattan Elevated had been successfully performed by electricity for years in other places before a realization on the part of its management that electricity as a motive power was cheaper, as well as the public indignation against the smoke nuisance in New York, finally forced the adoption of electricity as a motive power. In the case of the Baltimore tunnel it required an edict of the courts before the change to electricity was made.

There seem to be two reasons for this surprising lack of progress which electricity has made in displacing the steam locomotive, one a technical and the other a psychological reason.

First, to take up the technical reason. Up to within comparatively recently the only thing that the electrical engineer had to offer for trunk line operation was the well-known direct current motor with a maximum voltage of, say, 700, and the necessary rotary converter equipment that normally goes with such a system. To this system there are admittedly a number of valid objections. In spite of these objections, however, there has been no time within the last five years when the electric companies would not have undertaken to equip any trunk line on this continent, and, furthermore, they would have guaranteed to render at least the same service as is rendered by steam. As to the relative cost of such service by the direct current system compared to steam there comes in a question as to the character and density of the traffic. In many instances it could be shown that the trunk line traffic could be done more cheaply by electricity than by steam, even when the D. C. system was used. With heavy trains at long intervals, however, the handicap against electric traction increased until the point arrived where practically no saving could be shown. The advent of the alternating current motor changed all this. This point will be returned to later.

Perhaps of still greater import is the second reason offered to explain the lack of progress by electricity in displacing steam—the psychological one. The electrical engineer must not only develop a system which is capable of handling the traffic of a trunk line, but he must also convince the trunk line managers that he can successfully handle their traffic. Until the writer made the investigation referred to above he had remained under the impression that the trunk lines were installing electricity on such branch lines as were unquestionably suited to electric operation, and were in short becoming educated to appreciate the advantages of electric drive. That investigation, however, dispelled such ideas. It is not the trunk lines that are putting in the many high-speed and heavy service electric roads latterly so common, but a new type transportation engineer and one that is not bound by the traditions of the steam railroads. That this new method of transportation is a serious rival to the trunk line in many fields, and further, that it is bound to become a still more serious rival is unquestionable.

It is appreciated that there is reason why the trunk lines should hesitate to adopt on their main lines at once so radical a change as that of electricity as a motive power instead of steam. The steam locomotive is doing its work and is doing it well. The first essential of the trunk line manager is to move his freight and passengers, and to move them promptly, and that is what his steam locomotive is doing. Electricity, therefore, is not a necessity, he reasons; it is only an improvement—and of that proposition he is by no means convinced and apparently does not desire to be convinced. All the electrical engineer asks is an opportunity to prove that he is prepared to do successfully the work that is now being done by steam. That such an opportunity has not been given is evident from the record referred to above, showing the remarkably few number of substitutions of electricity for steam.

But now to return to the technical question. Briefly, the question is—Can trunk line traffic be handled economically by electricity? Since the advent of the single phase A. C. motor our answer is an emphatic YES. With the direct current system there was, perhaps, some doubt, but that is entirely removed by the single phase motor.

The advantages of the alternating over the direct current systems are apparent. Those which pertain particularly to heavy traffic are:—

1st—Elimination of the trolley voltage limit resulting in

(a) Reduction of the current to be collected by use of higher trolley voltages.

(b) Ability to use overhead contact conductors rather than third rail.

(c) Increased economy both in copper and power.

2nd—Elimination of the rotary converter.

It is in the elimination of the trolley voltage limit set by the maximum allowable voltage that can be put on a D. C. motor that the principal advantage accrues to the A. C. system. To do the work that is now done by the steam locomotive requires the application of an enormous power. To get this power at even the maximum voltages allowable in D. C. work involves currents which would often run from 4,000 to 8,000 amperes for the operation of a single train. The delivery of this amount of power from the sub-stations to the trains means both expensive conductors and large losses. But the expense and the loss are perhaps not the greatest problems. These currents must be taken from the conductors into the trains through a moving contact. This requirement in turn demands a working conductor with a large surface, and even under the most favorable conditions, is a problem that demands the most careful consideration. The usual solution is the installation of the third rail. This furnishes a working conductor with both a large surface and large current carrying capacity. But the expediency of equipping trunk line railway systems with third rail is, to say the least, doubtful. An overhead conductor is preferable for many reasons. Raising the voltage of the working conductor cuts this Gordian knot at once. For trunk lines a trolley voltage of 3,000 might be considered as a minimum and 10,000 volts would be proposed without hesitation. In fact, this latter voltage has been successfully used abroad under circumstances much more trying than would obtain with a single phase system, in that all three conductors of a three phase system with 10,000 volts between any two were used as working conductors. In the single phase system only a single overhead conductor need be used.

Since the cost of conductors to take power from the sub-stations to the trains is the greatest single item in the D. C. system, it is evident that this raising of the trolley voltage is a large factor in cutting down the cost of the A. C. relative to the D. C. system.

The elimination of the rotary converter is probably the next difference in order of importance. Not only does the use of alternating current eliminate a large element of first cost and an element of loss averaging probably 10 per cent., but by making available higher trolley voltages it also makes the total number of sub-stations smaller and eliminates the necessity of skilled attendance at the sub-stations that are used.

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* Paper read before the Canadian Electrical Association.

There are a number of other points of advantage, but those mentioned above are the principal ones.

When we come to consider trunk line traffic with electricity as a motive power there are two distinct problems to discuss —

1st—Electricity vs. Steam, and

2nd—Direct Current vs. Alternating Current.

As to the latter question there is no doubt. The alternating current system is the better in practically every particular. The main reasons are given above.

As to the first question there is perhaps cause for greater discussion than on the second, but to my mind there is no greater cause for doubt.

The following points of advantage in electric drive for trunk lines may be offered:—

1ST.— REDUCED WEIGHT OF LOCOMOTIVES.

Forty-five per cent. of the weight of a steam locomotive and tender available for traction is about the average obtained at present. In the electric locomotive every pound of weight is available for traction. The weight of an electric locomotive to do a given service may therefore, so far as tractive effort is concerned, be cut down to at least one-half that required by steam. In ordinary practice, too, the weight of the locomotive and tender constitutes from 5 per cent. to 25 per cent. of weight of the train. Electric traction can therefore by this one consideration save from 2 1-2 per cent to 12 1-2 per cent. of the power now required under steam service. Or to put it in another way, the live freight per train may be increased with electric traction—considering tractive effort alone—from 2 1-2 per cent. to 12 per cent. over steam.

2ND.—UNIFORM TORQUE.

Another condition that will serve to enhance still further the difference in weight is the uneven torque exerted by the steam locomotive within a single revolution of the drivers as compared with the perfectly even torque as exerted by the electric locomotive. A given weight on drivers is therefore more effective in the electric than in the steam locomotive, or, in other words, for a given useful tractive effort less weight is required on the drivers of an electric than a steam locomotive.

3RD.—PERFECTLY BALANCED DRIVERS.

The electric locomotive not only has a perfectly even torque at all points in the revolution of the drivers, but the drivers are always in perfect balance. In this respect it is decidedly superior to the steam locomotive where a perfect balance is an impossibility. At high speeds, therefore, the pounding of the steam locomotive on the track is one of the greatest elements in the deterioration of the permanent way. This element of deterioration of track would be entirely avoided by the use of electric drive.

4TH.—FEWER REPAIRS.

Compared to the electric motor the steam locomotive is an extremely delicate and complicated piece of apparatus. Imagine, for an instant, if you can, a steam boiler and engine operating under the conditions met and successfully met by the street railway motor in everyday practice. Railway motors have been known to make a mileage of as much as 450,000, requiring renewal of bearings only. Such a record with a steam engine and boiler under such conditions is unthinkable, as well as unreasonable to expect in view of the greater number of parts and the reciprocating motion.

On account of this greater sturdiness and less liability to damage on the part of the electric locomotive, it follows that to render a given service fewer electric than steam locomotives will be required, because the proportionate number in the round house will not be so great. The result, therefore, is not only a smaller repair bill but also a smaller number of machines to provide, house and care for.

5TH.—UTILIZATION OF WATER POWER.

The use of electric traction gives an opportunity for the utilization of water power that is impossible with steam. This point is of particular interest to Canadians, both because of the scarcity of coal and the abundance of water power. The same reason for the consideration of electric drive holds true for a large part of Western United States. This same consideration has caused the Swedish Government to determine upon a change on all the railroads of Sweden from steam to electric drive, and the first active steps looking toward this change has already been taken.

6TH.—MULTIPLE CONTROL.

The electric drive lends itself easily to distant control. It is not necessary, therefore, with electric drive to have the point of application of power and the intelligence that governs the application of that power at the same place. It is possible to subdivide the electric drive into relatively small units and place them at intervals through the train, still retaining control over the individual units at a central point. This avoids both the necessity of concentration of weight at the front of the train as well as the excessive draw-bar pulls, both of which problems are of no small dimensions in steam practice.

7TH.—SMOKE AND CINDERS.

The abolition of the smoke and cinders of the present steam locomotives, although, perhaps, it does not add to the economy of the electric system, still it is an advantage in its favor that would be vastly appreciated by the travelling public.

8TH.—ECONOMY.

Practically all the points above mentioned are in the direction of increased economy. In addition, however, we have, in case steam power is used, the vast difference between the economy that can be obtained from relatively large stationary engines operated in conjunction with condensers on the one hand, as against the locomotive on the other, which must necessarily run non-condensing and in which the losses by radiation, relatively small grate area and enormous changes in load are necessarily severe. The question of relative economy between steam and electric motive power on trunk lines was considered by Mr. A. H. Armstrong, in a paper read by him before the Canadian Society of Civil Engineers, November 19th, 1903. From his analysis and conclusions it is safe to assert that nine-tenths of the trunk line traffic of this continent can be operated more economically by electricity than by steam. This showing is made, too, on the basis of using steam generated power. The showing is bound to be much better where water power is available, as is the case practically throughout the whole of Canada.

The foregoing remarks have only touched the surface of this question and this discussion is not intended to be exhaustive. A complete discussion would take up vastly more time than has been allotted to this paper. If those to whose attention these words come carry away two ideas the writer will be satisfied. These are:—

1st—That there is some merit in the proposition to operate trunk lines by electricity ; that it is at least worth investigation.

2nd—That the electric companies are not only prepared to build equipments for trunk lines, but also are prepared to guarantee their successful operation.

THE STATISTICS OF CANADIAN PROGRESS IN ELECTRICAL APPLICATIONS.*

By George Johnston, Dominion Statistician.

The 24th May will be the sixtieth anniversary of the sending of the first Morse message over a telegraph wire.

There are now 1,764 private and government cables with a length of 204,527 nautical miles.

On the land there are 1,025,700 miles of line and 3,978,500 miles of wire. These represent an outlay of capital equal to 500 million dollars. Add the outlay for cables and there is a total outlay of 850 million dollars to provide the means for transmitting wire messages by sea and by land.

Over head and under seas there is a daily transmission of one million four hundred thousand telegrams and 36,000 cable messages ; the totals being 478,330,000 land messages and 13,140,000 cables in the year 1903.

This is the minimum, for in South Africa (for instance), there are thousands of miles of line which are in the hands of companies that are not required to make returns. Another fact has to be taken into consideration and that is that these figures do not include the telegrams sent by railways in the management of their own business. These number many millions in the course of the year. Thus Russia in 1902 included the telegrams, despatched hither and thither over that vast country in connection with the running of her railways, and the result was a total of 101,639,542 telegrams, whereas in the year before (1901), when railway telegrams were not included the messages sent numbered only 20,000,000.

A third fact must be kept in mind. In Canada the press messages are not included in the number reported. Everyone knows the important part the newspaper telegraph service plays in such a country as Canada. Divided by ten to represent an ordinary message the millions of words of the "flimsy" of the Press would far exceed the other messages sent and delivered in the course of the month or year and representing the business, the social and the other activities of the country. No estimate can be made of the number of these messages. It is plain, however, that at least a million four hundred thousand messages pass to and fro every day of the three-hundred and sixty-five days of the year. All this from the one or two telegrams which passed on the 24th May, 1844, when the Morse system turned the plaything of science into an instrument of practical everyday use.

The countries which most use the telegraphic mode of communication are the British Empire, the United States, Germany, France, Austria-Hungary.

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* Paper read before the Canadian Electrical Association.

The British Empire has 218,000 miles of line, nearly one million miles of wire, and sends and receives 127,000,000 messages.

Great Britain despatches and receives 92,471,000 messages or 222 per 100 of her population. Her daughters follow her illustrious example. Australia even goes beyond her, sending 223 messages per each one hundred, while New Zealand, that wonderful sister under the southern cross, goes far beyond mother, sisters, cousins, aunts or anybody else, topping the list with 610 telegrams per one hundred of her population. Canada does not make a good second, her record being only 101 messages per one hundred of her population. The African possessions of the British Empire, notwithstanding the fact that only a comparatively small proportion of the messages actually sent, are included in the available statistics exceed in the per head number, the record of Canada.

Of outside nations Belgium holds the record, her telegraphic messages numbering 207 per one hundred of her population. Argentina comes next with 146 messages per one hundred of her population. The United States does better than Canada having 120 messages per each one hundred of the population. France slightly exceeds the United States with 121. Germany is considerably below the other principal countries, having a record of 80 messages for each one hundred of the population. In the matter of miles of wire Canada somewhat exceeds the United States. If the latter had as many miles as the Dominion in proportion to population it would have over 200,000 miles more than it has.

The table being Appendix "A" gives as complete a list as I have been able to make up.

The employment of electricity, that subtle fluid of whose properties we know much without knowing anything of itself is by no means limited to the circulation of telegraphic messages among the nations of the world.

ELECTRICAL PROPULSION.

It is about sixteen years since the scientific practicability of propulsion by means of electricity was proved beyond dispute.

In the United States there are to-day about eleven hundred street railway systems*, the motive power of which is electricity. There are 25,800 miles of track, the capitalization is $1,630,000,000, and the funded debt $1,275,000,000; the earnings were over $240,000,000 last year. Our neighbors have made great progress. They have 322 miles of electric railway to each million of the population of continental United States. These carried 5,000,000,000 persons or about 65 times the population, and about eight times as many as the steam-driven railways. Canadians have no cause to feel inferiority. Our electric railways carried last year 167,704,000 passengers or about thirty times the population of the Dominion. When it is recollected that the urban population of the United States forms over 37 per cent. of the whole, while Canada's town population is only 26 per cent., it is evident that our electric railways come out well in a comparison and give promise of doing better in the future as Canada's urban population, following the continent's trend, increases its proportion. Our electric railways carried, like those of the United States, about eight times as many passengers as our steam railways carried.

I believe that Hamilton claims the honor of being one of the first cities in Canada to adopt electricity as the motive power of street railways, the Hamilton Street Railway Company having been equipped with electricity in 1892, the Ottawa Electric Railway Company beginning its career in July, 1891. Our development is, therefore, all within eleven or twelve years. That of the United States began in 1888.

ELECTRIC RAILWAY STATISTICS OF CANADA.

The following table gives particulars of Electric Railway Companies during the years ended December 31, 1901-1903: —

	1903.	1902.	1901.
Total number of railways sending returns	46	44	43
" miles of track, single	454.75	421.39	376.35
" " double	192.54	188.09	179.10
" motor cars	2,053	1,895	1,853
" trailers	298	326	302
" snow-sweepers and ploughs	109	97	85
" miles run	39,721,153	36,711,130	34,547,975
" passengers carried	167,703,958	145,609,993	132,885,258
" employes	7,439	5,427	5,443
Total amount of capital paid up	$29,838,326	$25,961,254	$24,734,040
" bonded debts	$17,013,758	$15,794,408	$14,166,225
" gross earnings	$ 7,777,324	$ 6,865,907	$ 6,283,666
" gross expenses	$ 5,018,779	$ 4,140,490	$ 3,699,283

MILEAGE IN EACH PROVINCE IN 1903.

	Single Track.	Double Track.
Ontario	273:14	87:64
Quebec	96:09	82:57
British Columbia	41:75	6:25
New Brunswick	10:06	2:50
Nova Scotia	23:71	1:58
Manitoba	10:00	12:00
Total	454:75	192:54

The following table gives the number of employees, passengers and others killed and injured on Electric Railways in Canada for the year ended June 30, 1903, also totals for 1902: —

Causes	Employees.		Passengers.		Others		Total.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Falling off trams	2	18		71			2	89
Jumping off trams			5	318		2	5	320
Struck by engine or cars	1		3	42	8	117	12	159
Head out of window				3				3
Coupling cars		6						6
Collisions	2	24	1	34		26	3	84
Walking on track		1		18	13	57	13	76
Other causes	2	13	1	18	1	10	4	41
Total, 1903	7	62	10	504	22	212	39	778
" 1902	2	30	8	413	22	120	32	563

In the Statistical Office we began to obtain returns in 1898. The following is the return for that year: —

Number companies sending returns	35
Total number miles of track	635
Number of cars	1,379
" " trailers	382
" " snow-sweepers, ploughs	69
" " miles run	28,547,908
" " passengers carried	94,616,344
" " employees	4,004
Total amount capital paid up	$18,309,876
Bonded debt	10,454,452

I think that there was some misunderstanding about the miles of track. Otherwise the return for 1898 appears to me to be fairly correct. In 1900 the return gave 688 miles. In 1901 we asked for the miles of track, single and double, in order to eliminate the apparent confusion and obtained as the result answers which aggregated 555 1-2 miles. The latest return gives a total of 647.29 miles, showing an increase of 92 miles since the new century came in.

TELEPHONES

The summer of 1904 is the 30th anniversary of the invention of the telephone. In 1874 Mr. Graham Bell, then on a visit to his parents, who lived in Brantford, made some laboratory experiments which proved that speech could be transmitted by wire. Two years later, August, 1876, the first transmission of speech over a telegraph wire took place in Brantford. In 1877 the telephone went into commercial use, this city of Hamilton being the first to establish it. From that beginning the use of the telephone has been constantly on the increase. The first returns the Statistical Office secured showed that in 1893 Canada's equipment was 44,000 miles of wire; 33,500 instruments, by means of which 72,500,000 messages were sent in the year. In the ten years since the number of instruments has increased to 81,500 and of messages to 253,970,000, an increase of 133 per cent. in instruments and of 250 per cent. in number of messages—instruments 1 1-2 times more; messages [illegible] times more.

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* In1900 the United States Census returns for 1899 gave 871 street railways, chiefly electric.

Taking the population of the last census there is in Canada one telephone instrument to every 65 persons.

By provinces

Ontario, one telephone to every			59.7	persons
Quebec,	"	"	63.8	"
Nova Scotia,	"	"	99.4	"
New Brunswick,	"	"	85.3	"
P. E. Island,	"	"	215.0	"
Manitoba	"	"	51.5	"
N. W. Territories,	"	"	251.3	"
British Columbia,	"	"	33.4	"

According to our list there were on the first of this year 56 companies in Canada, divided by provinces as follows :

Twenty in Quebec, eleven in Ontario, seven in New Brunswick, six in Nova Scotia, one in P. E. Island, two in Manitoba, three in the Northwest Territories, one of these being in the Yukon, and six in British Columbia—the Bell Telephone Co. being counted three times, one in Quebec, one in Ontario, and one in Manitoba. Actually there are fifty-three, and we obtained this year returns from all but seven.

Some of them are, I believe, under the control of the Bell Telephone Company and their returns are included in that Company's returns.

(Just here I may note with satisfaction that all responded to our request with promptitude and showed sympathy with our efforts to procure the statistics published in the Year Book of Canada.)

Our neighbors to the south in 1900 showed a per capita of one telephone in 40, while in some places, such as San Francisco, it had reached one in twelve (U. S. Census Bulletin). The latest statistics indicate a per capita of one in thirty-eight. This rate of progress is exceeded by Denmark, in which country, according to Mr. F. Dagger in the Canadian Engineer, the per capita is one in every fourteen. Canada has not used the telephone to the same extent, but we appear to be making great strides forward, and British Columbia has come within measurable distance of the greatest of telephone-using peoples, the people of Stockholm, in which city there is one telephone in every eight persons.

The Dominion began to construct telephone lines with a commercial end in view. in 1877, as already stated. As far as our somewhat incomplete statistics show, fourteen telephone companies now in operation began distributing "hellos" in the decade 1880-1889; fourteen in 1890-1899 and thirteen in the present decade. Of the remainder we have no record.

The usefulness of the telephone in business in rural communities is well illustrated by the practice in the great fruit growing valley of Nova Scotia. The steamer at Halifax has loaded up with all she purposes carrying of other articles. She is to sail on Saturday afternoon for Liverpool. Her agents telephone to Kentville and Wolfville on Thursday that there is space left for say 2,000 barrels of apples. Kentville and Wolfville telephone to the sub-agents of the London (Eng.) fruit dealers, "How many barrels can you send to Halifax?" These sub-agents jump into their gigs and in an hour have arranged with the orchardists as to the number of barrels to be delivered on Friday evening at each station along the railway. Then they telephone the result to head stations. Cars are provided in accordance. The fruit is shipped to Halifax Friday night, put on board the steamer the next morning and off goes the steamer, the fruit having been exposed to high temperature hardly at all, the orchardists having had ample time to get their barrels repacked, the railway full opportunity to supply the necessary cars and the steamer being able to take on board the freight without exposing it to the influence of adverse conditions of weather on the wharf.

The number of telephone messages per annum for different countries is :

[illegible]	187,002,352
[illegible]	766,226,337
Great Britain and Ireland	723,246,368
Austria-Hungary	147,513,138
[illegible]	59,210,855
[illegible]	38,753,367
[illegible]	26,670,381
[illegible]	31,460,979
[illegible]	1,723,347
United States	3,002,000,000

ELECTRIC LIGHT, HEAT AND POWER COMPANIES IN CANADA.

The equipment of these with which Canada has provided herself is of comparatively recent date.

There is no mention made of electricity in the census records of 1881.

In the census of 1891 the following information is given, 1901 being given for comparison :

	Manufacture of Electrical Appliances, Electric Supplies.		Electric Light.	
	1891.	1901.	1891.	1901.
*Establishments.	No. 13	25	23	58
Capital......	$1,520,000	$5,267,397	$3,185,257	$11,891,025
Hands......	No. 408	1,922	630	899
Wages......	$ 158,500	$ 846,618	$ 237,348	$ 451,047
Output......	801,752	3,032,252	845,134	2,008,017

*Establishments having five hands and over.

In addition the census of 1891 gave as follows :

ELECTRICAL APPLIANCES AND SUPPLIES

(Establishments Having Under 5 Employees.)

Establishments	No. 10
Capital	$43,813
Hands	No. 17
Wages	$14,615
Output	$63,100

In the census of 1901 no provision was made for the collection of statistics of establishments having under five hands, so that for purposes of comparison we must take the development which has occurred in establishments having more than five hands.

These show an increase in the ten years as follows :

Establishments (Electrical Appliances and Supplies.)

Capital	—increase	in	ten	years—	246	per cent.
Hands employed	"	"	"		346	"
Wages paid	"	"	"		434	"
Output	"	"	"		278	"

The statistics of electric light, heat and power plants having five hands have been given before. In addition to these there were in 1891, 57 establishments having fewer than five hands, with a capital of $928,514; employees 133, receiving in wages $60,336 and having an output of $309,015 of finished products.

The total equipment of Canada then of 1891 in light, heat and power establishments was :

Establishments	80
Employees	763
Capital	$4,113,771
Wages	$ 297,684
Output	$1,154,149

Comparing these totals with those of 1901 which include only establishments having five hands the evidence is strong that there has been a marvellous increase in the development of electric light, heat and power applications in Canada.

The Statistical Office has been able to secure a fairly complete return of the Electric Light Companies for 1903, so that we can give data which enable us to ascertain the extent of the development in twelve years with a successful approach to accuracy.

The first point necessary for a comparison of the equipment of electric light works possessed by Canada is the number of establishments.

By provinces these were in :

Provinces.	1891.	1903.
British Columbia	2	17
Manitoba	2	7
New Brunswick	7	13
Nova Scotia	7	22
Ontario	48	199
P. E. Island	2	3
Quebec	9	49
Territories	2	6
Total	80	316

This is a marvellous development in twelve years. It shows how fully Ontario has entered into the spirit of the age and what a full equipment of the great force of modern times she has provided for herself.

In the 316 establishments of 1903 there were 1,786 hands compared with 762 hands in 1891. There was a capital of over $20,000,000 invested against $3,200,000 in 1891.

Another result of our enquiry was that in the Province of Ontario about 100 of the plants were found to be using coal or wood, about 60 using water-power and 35 steam and water, remainder not stating the particulars. In Quebec six establishments used coal or wood; 38 utilized the water-power of the province and seven combined water-power and steam power. In New Brunswick 11 obtained power from coal or wood and 2 from water. In Nova Scotia 16 used coal and 6 water. In P. E. Island 2 coal and 1 water. In Manitoba 5 coal and 2 steam and water. In the Territories 4 coal and 1 water and steam. In British Columbia 8 coal or wood, 8 water and 1 water and steam.

Except in the Province of Quebec the majority of the plants use coal or coal and wood. Sometimes sawdust is utilized.

ELECTRIC LIGHTING IN CANADA.

An analysis of the statistics of electric lights prepared by me for the Year Book for 1903 shows that in 1903 there were 324 electric plants* in the Dominion with 14,780 arc lights and 1,212,861 incandescent lights. Taking the arc as equal to ten incandescent lights the country had on the 30th June last 1,360,661 lights in use. This is an increase of 236,865 lights in the twelve months, or over 21 per cent. Where there were five lights in 1902 there were 6 in 1903. The growth since 1898 has been: Establishments, 1903, 324; increase 65. Arc lights, 14,780; increase, 4,391. Incandescents, 1,212,861; increase, 749,246, showing an increase of 42 per cent. in the number of arc lights and of 161.6 per cent. in the incandescents.

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*Some of these are absorbed by others but made their returns to the Department of Internal Revenue separately and are therefore given here separately. In the previous tables they are dealt with under the return of the absorbing companies.

Of the provinces, Ontario is far away the chief employer of the electric light. This province had 203 of the 324 plants in use in the Dominion. It has considerably more than one-half the total number of arc lights and 47 in each hundred of the incandescents. Thirty-four municipalities in the province supply themselves with electric lighting.

The Province of Quebec has 53 plants, 3,853 arc lights and 409,503 incandescents. It is, therefore, behind Ontario by 4,571 arcs and 158,990 incandescents. It has made, however, greater proportionate gain since 1898 than Ontario, the gain in arcs being: Ontario 36.2 per cent, Quebec 47.6 per cent.; and in incandescents, Ontario 138.6 per cent. and Quebec 212.3 per cent. During the period 1898-1903 the number of plants in Quebec increased by 13.

The largest single plant in the Dominion is that of Toronto, with its 170,000 lamps; arcs being taken as each equal to 10 incandescents. The next largest is that of the Lachine Rapids Hydraulic and Land Company, Montreal, 158,503. The third in size is the Ottawa Electric Company with 111,027 lights.

The other provinces have made considerable progress. To the west, Manitoba has increased in 1898-1903 its arc lights from 162 to 375, and its incandescents from 13,800 to 31,905.

The North-West Territories have not increased as rapidly as the other parts of the Dominion, their arcs numbering 29, an increase of 4 in the period named, and their incandescents numbering 6,677, an increase of 1,997.

British Columbia shows the largest proportionate increase of any of the divisions of Canada, its increase of arcs being 377 or 82 per cent. and of incandescents 74,297, or 257 per cent. In 1898 British Columbia and Nova Scotia had almost the same number, British Columbia having 7 more arcs and 169 more incandescents; yet Nova Scotia has increased the number of its incandescents by 32,140, or 11.16 per cent. The three Maritime Provinces had in 1898, 951 arc lights and 46,977 incandescents, and in 1903 they had 1,267 arcs and 93,120 incandescents, an increase of thirty-three and one-third per cent. for arcs and of over 98 per cent. for incandescents.

The imports of the country as well as the increased manufactured output of our own establishments attest the vigorous development of electricity as the harnessed servant of humanity. Of electric arc lights and carbon and carbon points we imported during the past fourteen years an average of $35,000 worth a year, and the last two years' average was $76,200. Of electric light apparatus and batteries we imported in fourteen years an annual average of $407,000, and the last two years the average was $1,090,050. Of electric motors and meters in fourteen years we imported $151,700 a year. The average of the last two years is $378,300.

Countries.	Year.	Miles of Line.	Miles of Wire.	Number of Messages	Number of Offices.	Number of Messages per Head of Population.
Great Britain	1903	49,450	480,400	92,471,000	12,129	2.22
Australia	1902	45,313	121,818	8,431,372	3,102	2.23
New Zealand	1902	7,749	22,672	4,713,351	1,103	6.10
India and other Asian. Poss.*	1902	57,495	190,887	6,749,372	2,006	.02
African Possessions	1902	17,885	38,832	7,555,500		1.08
Canada	1903	36,780	96,728	5,313,800	3,004	
Newfoundland and B. W. Indies	1902	3,308	15,187	1,654,000	300	.92
Gibraltar and Malta	1902	67		33,500		.15
Total British Empire		218,077	966,524	126,921,895	21,644	
Abyssinia	1902	1,056	3,168	158,400		
Austria-Hungary	1902	39,372	198,303	31,554,715	9,228	.69
Argentina	1902	29,397	58,656	7,000,000	520	1.46
Belgium	1902	4,047	21,874	14,252,100	1,372	2.07
Bolivia	1902	2,465	8,625	1,075,000	68	.47
Bosnia	1902	1,803	4,873	427,452	134	.25
Brazil	1900	14,710	27,720	1,505,042	1,003	.10
Chili	1902	11,060	68,710	4,879,719	608	1.57
China	1902	14,000	49,000	3,430,000	250	.01
Columbia	1898	8,600	25,800	600,000	448	.15
Congo Free State	1902	888	3,108	62,160	40	
Costa Rica	1902	840	2,940	284,532	68	.92
Cuba	1902	2,300	3,450	430,125	153	.27
Denmark	1902	2,385	8,855	2,409,365	169	.98
Ecuador	1902	1,242	4,347	434,470	60	.31
France	1902	90,592	340,180	47,280,070	13,527	1.21
Colonies and Dependencies:						
Algeria	1901	6,520	18,240	2,369,456	539	.50
Tunis	1901	2,420	5,500	978,000	122	.51
Other Possessions		10,700	32,100	1,605,000	300	.40
Germany	1902	83,526	309,644	45,216,963	25,621	.80
Greece	1901	3,830	5,590	1,205,095	241	.50
Guatamala	1901	3,490	10,470	929,619	157	.59
Honduras	1902	2,825	8,475	618,000	168	1.05
Italy	1901	28,472	107,810	11,682,366	6,078	.36
Japan	1903	x16,128	78,710	18,073,407	2,197	.38
Korea	1902	2,170	6,510	325,500	325	.06
Luxemburg	1902	656	1,390	87,300	196	.37
Mexico	1901	43,675		2,665,998	377	.19
Montenegro	1902	343	427	29,590	21	.13
Netherlands	1903	4,010	16,158	5,728,222	761	1.08
Colonies, East Indies	1901	7,518	22,554	729,316	389	.02
Nicaragua	1901	2,440	7,320	140,640	119	.28
Paraguay	1901	500	1,500	97,044	75	.15
Persia	1901	5,480	8,270	16,540	112	.00 2-10
Peru	1903	3,220		152,808	48	.03
Portugal	1902	5,301	11,688	4,054,230	461	.73
Portugal—Colonies of	1903	2,368	7,104	142,080	80	.01
Rumania	1902	4,350	8,780	2,318,683	1,866	.12
Russia	1902	106,417	325,978	*101,639,542		.15
Salvador	1902	1,920	5,760	715,084	135	.71
Santi Domingo	1902	430	1,290	40,000	65	.07
Servia	1902	2,300	4,925	1,092,527	145	.44
Siam	1902	2,900	7,700	154,000	360	.02
Spain	1901	20,170	47,470	4,627,713	1,534	.25
Sweden	1901	10,077	31,695	2,813,830	2,175	.55
Norway	1902	9,978	53,813	2,278,639	974	1.01
Switzerland	1902	5,556	23,765	3,273,784	2,137	.99
Turkey	1902	25,100	39,800	4,976,070	907	.21
Egypt	1903	2,562	10,868	x1,617,946	544	.16
United States	1903	196,115	1,029,983	91,391,443	23,567	1.20
Hawaii	1903	250	750	37,500	40	.24
Porto Rico	1903	470	1,410	70,400	70	.07
Phillipine Islands	1903	720	2,160	43,200	42	.00 1-2
Uruguay	1901	4,601	13,812	397,493	101	.01
Total Foreign Countries		854,268	3,099,028	430,118,178	100,697	
Grand Total		1,072,345	4,065,552	557,040,073	122,341	

*Including Railway Telegrams numbering 91,639,542.

xNot including State Telegrams.

*The statistics for Africa are very incomplete, many thousands of miles of line being in hands of companies not making returns.

xSubmarine cable 2,130 miles in addition.

It appears to me that the outlook for Canada is one that shows the country going forward by leaps and bounds in its application of electricity. Electricity will drive the carriages on the king's highway as well as those on the iron way. It will do our ploughing, our sowing and our reaping. It will make trolley parks an important part of the national equipment for recreation. If it does not help us into this life, it will help some (no one of this Association of course) out of it—by order of justice. It will do the nation's smelting and welding. It will supply from peat bogs fuel for Ontario and Quebec. In the form of the "wireless" it will make travel by sea along our coasts and estuaries as safe as travel about the streets of our towns. It will make our hats, cook our dinners and warm our toes. It will become so tamed to our service that it will with the message present a photo of the speaker, and cut out in one town a cheque on a bank written hundreds of miles away, and do it so well that the original will be destroyed and the transmitted cheque remain the only existing original. We already have twelve messages over the one wire. How many more who can say? We have in use a telegraph-telephone system by which our railways can employ the same wire for both simultaneously. Our surgeons use it to minister to mind and body diseased. Our warriors use it in the form of the wireless to transmit orders from the right to the left of an army in extended order and thus are able to set thousands moving as one at the same instant over miles of distance.

In fact the electrical engineer is dealing with a force whose uses have become and promise to become even more in the future than in the past, so varied that more than any profession a man has to be a hustler all the time or he will become a way-back even while he is positive he is well to the front. The up-to-date man of to-day is rear-guard to-morrow if he is not always on the alert, so rapid are the movements, so numerous the applications of the electrical forces.

Dept. Agriculture, Ottawa, May 16, 1904.

ALUMINUM ELECTRICAL CONDUCTORS.*

By Roderick J. Parke.

The use of aluminum for electrical conductors has grown to an extent which renders imperative the consideration of its possibilities when designing any system of distribution. It is so far the only material which possesses the requisite properties to render practical its substitution for copper. Previous to 1898 aluminum was little known in the commercial world, but since that year, when it was first placed upon the market in the form of solid drawn conductors, the consumption has rapidly increased, until 1902, the date of the latest complete statistics available to the writer, the world's product was estimated at 8,000 tons per annum. The corresponding production of copper is estimated at 497,000 tons per annum, for all purposes. The statistics available up to the present, however, show that the production and consumption of aluminum is rapidly increasing, and that it has become a very strong competitor of copper for electrical conductors.

There are now nine plants in the world producing aluminum, of which three are in America, two in France, and one each in Great Britain, Germany, Switzerland and Austria. The total power utilized in the production of the aluminum is from 36,000 to 40,000 h.p., practically all water power.

I will not burden this paper, nor intrude upon your time unnecessarily, by describing the process of the manufacture of aluminum further than to say that it is derived from a species of clay, technically termed "bauxite," of which I have a sample here which I will hand out for inspection. One of the principal processes of the manufacture of aluminum is its reduction from the bauxite by the electric furnace after the bauxite has been subjected to several preparatory processes.

The following figures are for commercial aluminum and commercial copper of sizes commonly used in practice, the copper being hard drawn.

	Aluminum.	Copper.
Specific gravity	2.68	8.93
Conductivity (Matthiessen standard)	62.	97.
Tensile strength (per square inch)	28000	45000
Co-efficient of linear expansion (per F°)	.0000128	.0000093
Co-efficient of temperature resistance	.00114	.00117
Modulus of elasticity	9,000,000	14,000,000

Using the above figures we find that the cross section of aluminum will have to be $\frac{97}{62}$ or 1.564 times that of copper, to have the same resistance per foot. The weight of the aluminum will therefore be 2.68 x 1.564 ÷ 8.93 times that of copper, or .47.

The tensile strength of the aluminum will be 28000 x 1.564 ÷ 45000, or .96 that of the copper.

The diameter of the aluminum will be $\frac{\sqrt{1.564}}{\sqrt{1}} = 1.25$ that of the copper.

The price of aluminum for equalcost would be $\frac{1}{.47}$ or 2.13.

Tabulating these results we have:—

	Aluminum.	Copper.
Cross section for equal resistance	1.56	1
Diameter for equal resistance	1.25	1
Weight for equal resistance	.47	1
Tensile strength for equal resistance	.96	1
Price for equal cost	2.13	1
Rate of temperature change (resistance)	1.	1

To demonstrate ocularly the relative proportions of aluminum and copper having a like resistance, I have two specimens here which I will hand to you for inspection. One is a piece of 500,000 c.m. stranded copper conductor, the other is a piece of aluminum stranded conductor having a cross sectional area of 625,000 c.m., or 1¼ times that of the copper specimen, the resistance per 1,000 ft. being the same for each.

By inspection of the above table we see at once that the principal difference which exists from an engineering standpoint is that aluminum possesses less than half the weight of copper for equivalent resistance. This is a marked advantage and results in benefit in three ways.

1st. The cost of transportation of aluminum is less than that of copper.

2nd. The cost of erection of the aluminum is less.

3rd. The durability of the line is greater and cost of maintenance is less on account of the smaller strains to which poles, crossarms, pins and insulators are subjected.

An additional advantage of aluminum is that on account of its peculiar nature, it retains, for years, some of the grease used in drawing, and this grease prevents any great amount of sleet from forming upon it, thus avoiding one of the serious causes of interruption to service over pole lines. This result is rather surprising and its announcement is often greeted with incredulity, but the fact has been noted often enough to be well established.

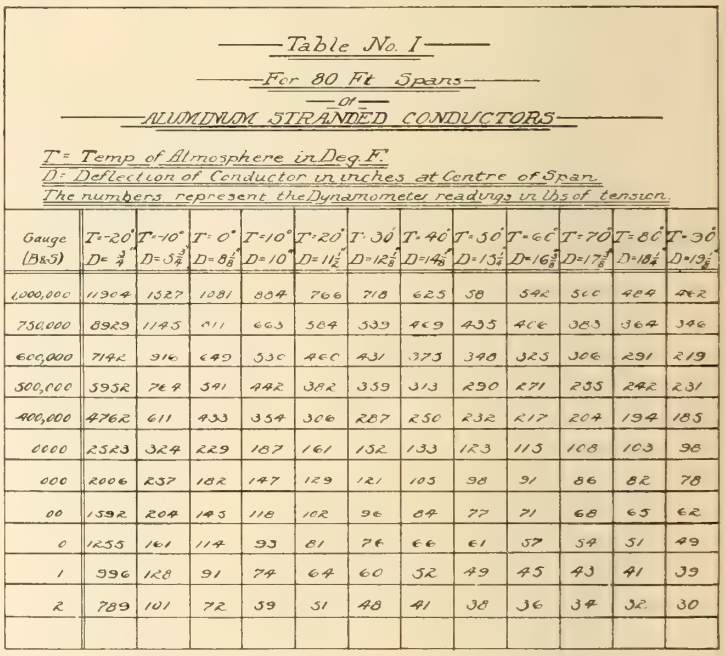

Table No. I

For 80 Ft Spans

of

ALUMINUM STRANDED CONDUCTORS

T= Temp of Atmosphere in Deg. F.

D= Deflection of Conductor in inches at Centre of Span

The numbers represent the Dynamometer readings in lbs of tension.

Gauge (B&S)	T=-20° D=¾"	T=-10° D=5¾"	T=0° D=8⅛"	T=10° D=10"	T=20° D=11½"	T=30° D=12⅛"	T=40° D=14⅝"	T=50° D=13¼"	T=60° D=16⅜"	T=70° D=17⅜"	T=80° D=18¼"	T=90° D=19⅛"
1,000,000	11904	1527	1081	884	766	718	625	58	542	500	484	462
750,000	8929	1145	811	663	584	539	469	435	406	383	364	346
600,000	7142	916	649	530	460	431	375	348	325	306	291	219
500,000	5952	764	541	442	382	359	313	290	271	255	242	231
400,000	4762	611	433	354	306	287	250	232	217	204	194	185
0000	2523	324	229	187	161	152	133	123	115	108	103	98
000	2006	257	182	147	129	121	105	98	91	86	82	78
00	1592	204	145	118	102	96	84	77	71	68	65	62
0	1255	161	114	93	81	76	66	61	57	54	51	49
1	996	128	91	74	64	60	52	49	45	43	41	39
2	789	101	72	59	51	48	41	38	36	34	32	30

To balance the advantages cited there are the following disadvantages:

1st. Difficulty in making joints.

2nd. Greater sag due to larger coefficient of expansion.

3rd. Insufficient strength for conductors of the sizes used for telephone and telegraph wires.

Referring again to the question of sleet affecting metallic conductors, the writer was informed by a friend who is an electrical engineer for one of the large companies in the States of a very practical illustration. He states that he was called to Kansas City to make an inspection of the Kansas City and Leavenworth Railroad. He happened to get there on a day while there was a very severe sleet storm in progress and he found the copper trolley wires so badly covered with sleet that it was almost impossible to run the cars at all, and they were running scrapers instead of trolley wheels, and they were compelled to keep a man on top of the car to assist in knocking the ice from the wires. On the other hand the aluminum feeders, located on poles adjoining the tracks, were entirely free from sleet, and he states that this condition was not due to the fact that the wires were carrying sufficient current to warm them, because that was not the case, as there was only one car on the line between the power house and the part of the line referred to and the feeder system was of ample size, so that the temperature rise was insufficient to have any effect in preventing the formation of sleet. In addition to this there would be from half an hour to an hour at a time when no car would be on the line at all, and then no current whatever would be passing over the line.

It does not follow, however, that sleet will never gather on aluminum wire anywhere, because in the neighborhood of railroads and manufacturing plants the wires are likely to become coated with smoke or some other foreign substance upon which the sleet will form. In general, however, it may be safely assumed that sleet does not form upon aluminum wires.

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*Paper read before the Canadian Electrical Association.

HARDNESS.

Aluminum being a softer metal than copper, more care must be exercised in handling it than is necessary with copper. A conductor is liable to be greatly weakened through the careless adjustment of the tie-wire or the handling of linemen's tools in erecting the wire. It is also liable to be seriously injured and its strength impaired if the wire be drawn over a road paved with sharp stones.

Table No II

For 100 Ft Spans

of

ALUMINUM STRANDED CONDUCTORS

T = Temp of Atmosphere in Deg F

D = Deflection of Conductor in inches at Centre of Span

The numbers represent the Dynamometer readings in lbs of tension.

Gauge (B&S)	T -20° D-1⅛"	T -10° D-7¼"	T = 0° D-10¼"	T = 10° D = 12½	T 20° D-14⅜	T = 30° D-16"	T-40° D 17¾	T 50° D 19"	T : 60° D 20⅜	T = 70° D-21½	T = 80° D 22¼	T = 90° D 23⅜
1,000,000	11904	1916	1352	1106	959	855	799	707	676	639	605	578
750,000	8929	1437	1014	829	719	644	600	530	507	480	454	433
600,000	7142	1149	811	664	575	515	480	425	406	384	363	347
500,000	5952	958	676	553	479	429	400	353	338	320.	303	289
400,000	4762	767	541	442	383	343	321	283	270	256	242	231
0000	2523	405	287	234	203	182	169	150	143	136	128	122
000	2006	323	228	186	162	145	135	119	114	108	104	97
00	1592	256	181	148	128	115	107	94	90	85	81	77
0	1255	202	143	117	101	90	84	74	71	67	63	61
1	996	160	102	93	80	72	67	59	57	54	51	48
2	789	127	90	73	64	60	53	47	45	42	40	38

It may be opportune at this point to offer a word of caution to those who use electrical conductors, whether of copper or of aluminum, namely, that too much care cannot be exercised in the handling of conductors, to avoid scratching and scarring. If the surface of the round wire be broken ever so little, the tensile strength of the wire is greatly weakened at that point, and in making tension tests of conductors the universal experience is that an otherwise perfect conductor will break at that point at which the slightest scratch is apparent. If any one will take a piece of No. 6 B. & S. copper wire and with the sharp blade of an ordinary jack-knife describe a circle around the wire by turning it under the blade of the jack-knife, putting no pressure upon the jack-knife except that coming from its own weight, it will be found that the wire can be broken in one or two bends, whereas if the surface be not so broken it will take anywhere from eight to twenty bends to break the conductor, depending upon the degree of hardness to which it has been drawn. Investigation will show that where wires have been scarred or scratched parallel with the circumference, the reduction of area, under tension, first commences at that point, upon the application of strain considerably below that corresponding to the elastic limit of the material, consequently when bare conductors have been erected without due care, it is sometimes found that their ohmic resistance has been considerably increased at points where the wire has been scratched, through the reduction of area caused by strains produced by low temperatures. The lower resistance might not be noticed in cold weather owing to the effect of the temperature co-efficient of resistance, but the increased resistance will almost certainly be noticed in warm weather. The increased resistance, of course, in any event may be negligible, nevertheless it is advisable to place much importance upon the fact that for erecting conductors made of any metal and intended for important line service, none but careful and experienced linemen should be employed.

TYING.

For tying aluminum wires from No. 2 B. & S. up to the largest sizes, No. 2 B. & S. solid aluminum wire should be used, and for any size smaller than No. 2. B. & S. a solid tie-wire having the same cross-sectional area as the stranded conductor should be used. The tie should be put on firmly enough to prevent the wire slipping through it in order that after spans and deflections have been set, the relative positions and deflections of the conductors shall be maintained permanently at all points. Care should be taken in putting on the tie-wire that the conductor is not pinched by the tie, nor injured by pliers.

For tying small wire the bridle tie will be found to give the best results. In making this tie, the tie-wire is passed completely around the insulator and the two are wound in opposite directions around the main conductor, being wrapped at least five or six times around it, one of the ends passing above the line wire and the other underneath, so that the main wire and the ends of the tie-wire lie side by side on the insulator. Any form of tie, however, which will hold the wire without pinching it will be found to be satisfactory.

JOINTS.

The difficulty of soldering aluminum is well known and, while it can be done, the operation in the majority of cases is attended with so much difficulty that unsoldered joints are preferable. The difficulty in soldering aluminum arises from three causes: First, because solder does not alloy with aluminum at a low temperature. It will alloy with copper at approximately 460 degrees F., but the alloying temperature with aluminum is about 200 degrees F. higher. Secondly, because of the high thermal conductivity of aluminum the latter metal conveys the heat away very rapidly from the solder and from the soldering iron, making it difficult to maintain a soldering temperature; and, thirdly, when aluminum is exposed to the air a thin invisible coating of oxide of aluminum instantly forms upon the surface, although in this respect aluminum is not different from all other metals, because the surface of any metal becomes covered with its oxide immediately after exposure to the atmosphere. It is well known that it is necessary to remove this oxide coating in order to permit of the formation of an alloy between the solder and the metal because the alloying can only take place on a clean surface of metal and an interposing film of oxide prevents the solder from coming into actual contact with the metal. In regard to other metals than aluminum the oxide coating can be dissolved by means of soldering salts, but no such salt or flux, so far as the writer can learn, has been discovered for aluminum, hence the difficulty in soldering it. Attempts have been made to use various materials as fluxes to remove the oxide coating of the aluminum, but the results have not been satisfactory, and in fact have been in most cases detrimental to the aluminum because of the resulting formation of a chemical compound which interferes with soldering instead of facilitating it.

For joining aluminum wires smaller than No. 4-0 B. & S. gauge the two ends are inserted into a piece of flattened tube and the tube given two and one-half twists by means of two pairs of ordinary wire connectors. This makes a perfectly satisfactory joint of low resistance and as strong as the wire joined. I have here a couple of specimen joints showing this method of joining the ends of No. 0 B. & S. aluminum. These samples I will hand to you for inspection. The question as to the mechanical strength of this type of joint has been answered to the writer's satisfaction at least, by submitting sections of wire having joints of this type in them, to a tension test, to destruction, the conductor breaking outside of the joint in every instance, thus showing that the joint is actually stronger than the wire. No soldier is used in making this joint.

Table No III

For 120 Ft Spans

of

ALUMINUM STRANDED CONDUCTORS

T = Temp of Atmosphere in Deg F

D = Deflection of Conductor in inches at centre of Span

The numbers represent the Dynamometer readings in lbs of tension

Gauge (B&S)	T -20° D-1⅜	T=-10° D-8⅝	T = 0° D-12¼	T = 10° D 15⅞	T-20° D 17¼	T-30° D [illegible]	T-40° D-2[illegible]	T 50° D 22¼	T-60° D 24½	T 70° D 25⅝	T 80° D [illegible]	T 90° D [illegible]
1,000,000	11904	[illegible]	1627	1288	1151	1030	946	870	814	768	[illegible]	695
750,000	8929	1725	1220	966	863	[illegible]	705	653	611	576	546	521
600,000	7142	1380	976	773	691	[illegible]	564	522	489	461	437	417
500,000	5952	1150	814	644	[illegible]	515	470	435	407	384	365	348
400,000	4762	920	651	515	460	[illegible]	376	348	326	307	291	278
0000	2523	487	345	273	244	220	199	184	173	163	154	147
000	2006	366	274	217	194	174	158	147	137	129	123	117
00	1592	307	[illegible]	172	154	138	126	116	[illegible]	[illegible]	97	93
0	1255	242	[illegible]	136	121	[illegible]	99	93	86	81	[illegible]	[illegible]
1	996	192	136	108	96	86	79	73	68	64	61	58
2	789	153	108	85	76	68	62	58	54	51	48	46

Larger sizes are conveniently joined in any of three ways. First, by means of the ordinary dove-tail cable splice. (The Niagara Falls-Buffalo line, consisting of 500,000 c.m. aluminum cable, is joined in this way and has been in use for three years and has given perfect satisfaction.) Second, by means of terminals compressed on the ends of the cables at the factory, these terminals being threaded and thus adapted to be united in the field by a threaded stud. To illustrate this type of joint I have a specimen which I will hand to you for inspection. I will ask you to note that the terminals are compressed upon the ends of the cables by hydraulic pressure, and a small cone is driven into the end of the cable, inside the terminal, thus causing the component strands to spread so that when tension is applied upon the cable and joint the tendency is to increase the resistance offered by the joint against pulling out. The male threaded piece for joining the two terminals has a right and left hand thread, the surface provided by the thread being about equal to the cross section of the conductor, consequently the strength of the two are about equally proportioned. It is customary to place these terminals on the ends of the cables before shipment from the factory, but this work can also be done in the field if a small portable hydraulic pump be made a part of the linemen's tool equipment. As to the liability of this joint unscrewing because of vibrations set up in the line from any cause, or variations of the strain due to variations of sag corresponding to the change in temperature of the atmosphere, you will notice a small hole in the side of the intermediate piece, into which a steel pin can be inserted for use as a lever and the joint can thus be screwed up very tightly.

Table No IV

For 150 Ft Spans

of

ALUMINUM STRANDED CONDUCTORS

T = Temp. of Atmosphere in Deg F

D = Deflection of Conductor in inches at Centre of Span

The numbers represent the Dynamometer readings in lbs of tension

Gauge (B&S)	T=-20° D=2⅝"	T=-10° D=[illegible]	T=0° D=14½	T=10° D=18⅛"	T=20° D=21⅜	T=30° D=24"	T=40° D=26⅜	T=50° D=28⅜	T=60° D=30⅜	T=70° D=32½"	T=80° D=34¼	T=90° D=35⅞"
[illegible]	[illegible]	2793	2337	1645	1428	1279	1164	1083	975	956	908	866
750,000	[illegible]	2096	1753	1234	1071	959	873	812	731	717	681	649
600,000	[illegible]	1677	1402	987	857	767	698	650	585	574	545	519
500,000	5953	[illegible]	1168	822	714	639	582	541	488	478	454	433
400,000	4762	1118	935	658	571	512	466	433	390	383	363	346
0000	2523	592	495	349	303	271	247	230	207	203	192	183
000	2006	471	394	277	241	215	196	182	164	161	153	146
00	1592	374	312	220	191	171	156	145	130	128	121	116
0	1255	295	246	173	151	135	123	114	103	101	96	91
1	996	234	196	138	120	107	97	91	82	80	74	72
2	789	186	155	109	95	85	77	72	65	63	60	57

Third, by inserting the ends to be joined into a cast sleeve and compressing the sleeves between dies in a small portable press. It was not convenient to obtain a sample of this type of joint, but it is practically the same as the screwed joint, except that there is only one piece into which the ends of the cable are inserted until they meet at the middle and the sleeve is then subjected to a heavy hydraulic pressure. I have not had an opportunity to subject this joint to a tension test, consequently do not care to express a definite opinion in reference to its efficiency. This type of joint has, of course, to be made in the field, although the manufacturers can affix a sleeve to one end of each cable, leaving the other end to be adjusted by the linemen.

Taps are made by means of aluminum clamps, one of which carries a lug into which the tap wire is either soldered or secured by set screws. Soldering into a lug is one of the pieces of aluminum soldering which can be readily accomplished. In this form of tap it is possible to also use copper "take-offs" instead of aluminum, provided that that part of the joint at which the copper and aluminum unite be covered with a permanent water-proof coating of compound or rubber in order to prevent electro-galvanic action between the copper and the aluminum and the consequent destruction of the aluminum at that point.

I should have mentioned earlier in this paper that aluminum is highly electro-positive to all of the other commercial metals. In the electro-chemical series of metals, in the order of the most positive first, aluminum is tenth on the list, zinc thirteenth, iron fifteenth, nickel seventeenth, lead twentieth, tin twenty-second, copper twenty-fourth, and carbon thirty-seventh, consequently if aluminum and any other of the above mentioned metals, or the carbon be brought into contact and subjected to moisture galvanic action immediately commences from the aluminum to the other metal or carbon, and the aluminum quickly becomes pitted, and if the action were allowed to continue the aluminum would ultimately be consumed just as the zinc in the zinc-carbon battery is consumed. On this account, therefore, it is highly essential that where aluminum is to be used in conjunction with any other metal in the open air the joint should be thoroughly protected from exposure to the atmosphere and moisture. This is not as difficult a matter to avoid as it would at first sight appear, nevertheless, where other things are equal the writer would recommend that aluminum take-off or branch conductors should be used instead of copper.

It will be seen from the above that the difficulties of making aluminum joints have been reduced to an extent which leaves almost no disadvantage whatever.

SAG, OR DEFLECTION IN SPANS.

The sag of aluminum conductors is somewhat greater than that of copper in hot weather and on ordinary spans on account of the fact that the co-efficient of expansion of aluminum is thirty-eight per cent. greater than that of copper. The sag is not as much greater as might be expected, however, because the lower modulus of elasticity of aluminum causes it to contract more as the strain is relieved from it and because the weight of aluminum, for equal areas, is only three-tenths that of copper, while the strength of it is two-thirds that of copper. This causes aluminum to start with a smaller minimum sag than copper.

One curious result of this is that whereas aluminum will have a maximum sag of three or four inches more than copper in a 100 foot span, it will have actually a smaller maximum sag in a 1,000 foot span, for while the span moves further, or deflects more rapidly than copper, for a given temperature change, it starts with so much smaller sag at low temperature that it never overhauls the copper when long spans are used. On this account, and that of its small weight, it would seem to be the best material for long span work.

Believing that the information arranged in a convenient form may be useful to any of the readers who contemplate using aluminum wire, the writer has prepared a set of tables, No. I to VII. inclusive, showing the tensions of the various sizes of aluminum stranded conductors from 1,000,000 circular mils to No. 2 B. & S. guage, when erected on standard spans ranging from 80 to 400 feet. These tables are based upon the table of tensions and deflections prepared by the Pittsburg Reduction Company and presented by Dr. Perrine and Mr. F. G. Baum in a paper which these authors read before the American Institute of Electrical Engineers at Philadelphia, May 18th, 1900. The tables given herewith provide for a minimum temperature of 20 degrees F. below zero, and a maximum temperature of 90 degrees F. The deflections are calculated on the formula for the catenary and the permissible tensions and corresponding deflections specified in these tables are based upon a maximum strain of 15,000 lbs. per square inch on the aluminum at 20 degrees below zero.

It must not be understood, however, that the figures given in these tables can, in practice, be made to correspond exactly with the tensions and deflections which the linemen will observe in the field when using the dynamometer, because other conditions are almost certain to have some effect upon the results, which conditions obviously cannot be taken into account in the calculation of tables owing to the fact that they are necessarily unforeseen and arise from conditions due to the topography of the country, strength and solidity of the supporting structure, etc., but they can be taken as a safe guide for the linemen in placing a limit of minimum deflection which must be allowed in order that the strain produced by the fall to minimum temperature shall not exceed the limit permissible for the aluminum, which in respect of these tables is placed at 15,000 lbs. per square inch. To demonstrate the

Table No V

For 175 Ft Spans

of

ALUMINUM STRANDED CONDUCTORS

T = Temp. of Atmosphere in Deg. F

D = Deflection of Conductor in inches at Centre of Span

The numbers represent the Dynamometer readings in lbs of tension

Gauge (B&S)	T=-20° D=3½"	T=-10° D=12⅝"	T=0° D=17⅞"	T=10° D=21¾"	T=20° D=25¼"	T=30° D=28¼"	T=40° D=30⅞"	T=50° D=33⅜"	T=60° D=35⅞"	T=70° D=37¾"	T=80° D=39⅞"	T=90° D=41⅝"
1,000,000	11905	3352	2370	1936	1676	1500	1370	1267	1177	1118	1060	1010
750,000	8928	2514	1777	1452	1257	1125	1027	950	883	838	795	757
600,000	7143	2011	1922	1162	1006	900	822	760	706	671	636	606
500,000	5953	1676	1185	968	838	750	685	633	588	559	530	505
400,000	4762	1341	948	774	670	600	548	507	471	447	424	404
0000	2523	695	492	411	348	313	284	263	244	232	220	210
000	2006	565	400	326	282	252	230	213	198	188	175	166
00	1592	447	316	258	223	201	183	170	158	147	139	133
0	1255	351	250	204	177	158	144	133	124	117	112	106
1	996	281	198	161	141	125	114	106	99	93	89	85
2	789	254	158	128	111	100	90	83	78	74	70	67

practical application of the tables, let us assume that the linemen are erecting a circuit of No. 4-0 aluminum stranded conductors on 200 ft. spans, and that the temperature of the surrounding atmosphere is, at the time of striking the sags, 80 degrees F. On referring to the table we find that the tension on the conductor under these conditions would be 267 lbs. absolute tension, and not the tension in pounds per square inch. The dynamometer reading, therefore, should be 257, which, other things being equal, would indicate that the corresponding sag should be 45½ inches. The value of the table becomes apparent in demonstrating to the linemen that at 80 degrees F. and 200 ft. span the deflection for No. 0000 aluminum conductor must be not less than 45½ inches. Of course the deflection can be greater if necessary and any figure less than 257 shown in the table would be on the safe side, assuming, of course, that any deflection allowed greater than 45½ inches does not cause the particular conductor to interfere with or approach too near to the next conductor below it. It will also be apparent that in a series of spans of 200 ft. a deflection of 45½ inches and a corresponding tension of 257 lbs. for No. 0000 aluminum at 80 degrees F. will result when the temperature lowers to 20 degrees below zero, in a strain of 2,523 lbs. absolute, on the conductor, corresponding to 15,000 lbs. per square inch.

Table No. VI
For 200 Ft. Spans
of
ALUMINUM STRANDED CONDUCTORS

T = Temp of Atmosphere in Deg F.
D = Deflection of Conductor in inches at Centre of Span.
The numbers represent the Dynamometer readings in lbs of tension

Gauge (B&S)	T=-20° D=4⅝"	T=-10° D=14¼"	T=0° D=20⅜"	T=10° D=24⅞"	T=20° D=28¾"	T=30° D=31⅛"	T=40° D=35¼"	T=50° D=38¼"	T=60° D=40¾"	T=70° D=43"	T=80° D=45½"	T=90° D=47¾"
1000,000	11905	3869	2711	2211	1917	1776	1538	1448	1355	1281	1211	1155
750,000	8928	2902	2033	1658	1438	1332	1153	1086	1016	961	908	866
600,000	7143	2321	1627	1327	1150	1066	923	869	813	769	727	693
500,000	5953	1934	1355	1105	958	888	769	724	677	640	605	577
400,000	4762	1548	1084	884	767	710	615	579	542	512	484	462
0000	2523	820	576	469	401	376	326	307	287	272	257	245
000	2006	652	457	372	323	299	259	244	228	216	204	195
00	1592	417	362	296	256	237	206	194	181	171	162	154
0	1255	408	286	233	197	187	162	153	143	135	128	122
1	996	324	227	185	160	149	129	121	113	107	101	97
2	789	257	180	147	127	118	102	96	90	85	80	77

The tension of 15,000 lbs. per square inch upon which the tables are based is assumed as being within the limit of elasticity of the aluminum; in other words, it represents the maximum strain which can be applied to a bar of aluminum one square inch in cross section which will not cause the bar to elongate too far beyond the assumed safe point, although not necessarily causing it to approach within close limits of the breaking point, as the latter is found at a tension of approximately 28,000 lbs. per square inch in pure aluminum, this figure varying under certain conditions, and characteristically according to the nature and quantity of alloy of any other metal or of impurity which may be present.

It will be noticed that reference is made in the tables to "dynamometer readings." The use of a reliable dynamometer for stringing aluminum wire is strongly recommended, as experience seems to indicate that it is a difficult matter to obtain linemen experienced in handling aluminum wire, or who can be depended upon to provide that proper sag shall be set when stringing the wire. The use of the dynamometer does not involve any greater expense for the stringing of aluminum conductors than its non-use when stringing copper conductors because, owing to lighter weight of the former, the material can be handled much more easily and quickly than the copper can, size for size.

The third objection for aluminum applies only to telegraph and telephone and similar work. The smallest size of aluminum which it would be advisable to use in pole line work is No. 4 B. & S. guage, which has a breaking strength of about 1,000 lbs., which is the minimum strength that should be allowed in any conductor on a pole line if uninterrupted service must be given over it.

The principal uses of aluminum conductors have been for railway feeders, high tension transmissions and busbars. Its use in Canada has not been very extensive, due to the fact that the beginning of its manufacture here is of rather recent date. But there are very few places in the United States where it is not found in service. Very little need be said about its use for railway feeders, which have absorbed nearly two-thirds of what have so far been used. This use, however, presents no problems with which engineers are not familiar. For power transmission its use has become very extensive. The longest and largest transmissions in the world are now made over aluminum. From information furnished me by one of the manufacturers of aluminum conductors I have selected the following list and data which may be of interest:

Locations.	No. of Cables.	Miles per Cable.	C.M. area of each.
Niagara Falls to Buffalo	3	20	500,000
Shawinigan Falls to Montreal	3	85	183,708
Electra to Mission San Jose	3	100	471,034
Colgate to Oakland	3	144	211,000
Farmington River to Hartford	3	11	336,420
Lewiston, Me.	3	3.5	144,688
Ludlow, Mass.	6	4.5	135,257

In addition to the foregoing list the lines of the Telluride Power Transmission Company, Utah, Colorado and Montana, use nearly 2,000 miles of wire, involving transmission distances of 130 miles.

In connection with the electrical transmission system of the City of Hamilton, the Hamilton Cataract Power, Light and Traction Company have installed three aluminum conductors between the city and the DeCew Falls power station of the company, a distance of approximately 35 miles. I do not remember the gauge of these conductors, but I do know that they are stranded and have been in service for some months.

DURABILITY.

The question of the durability of aluminum conductors has frequently been raised since they have been brought into active competition with copper, but so far the information available shows that aluminum has thoroughly established itself as a conductor material offering no disadvantages which are not, in other respects, proportionately found in regard to copper or iron. Aluminum is not readily oxidizable and the greater number of mineral acids seem to have no chemical effect upon it, but chlorine in any of its unstable combinations is more or less detrimental to it, particularly where the conductors are exposed to sea air or where they are installed within the vicinity of certain chemical works. In reference to the question of protecting the aluminum conductors in the vicinity of salt water, the writer has heard of the suggestion that the manufacturer should coat the conductors with a heavy coating of thick oil, which, owing to the porous nature of the metal, would be absorbed to a considerable depth and should for a long time afford a protection for the metal from the action of the chlorine contained in the salt moisture laden atmosphere. As this experiment, so far as the writer can learn, has not been put to a practical test and is an expedient of probably doubtful value in any event, the suggestion is mentioned here for what it may be worth.

Table No. VII
For 400 Ft. Spans
of
ALUMINUM STRANDED CONDUCTORS

T = Temp. of Atmosphere in Deg F.
D = Deflection of Conductor in inches at Centre of Span.
The numbers represent the Dynamometer readings in lbs of tension

Gauge (B&S)	T=-20° D=18½	T=-10° D=25¾	T=0° D=40	T=10° D=50	T=20° D=58	T=30° D=64	T=40° D=71	T=50° D=76	T=60° D=82	T=70° D=86	T=80° D=91½	T=90° D=96
1000,000	11904	7778	5422	4422	3834	3552	3076	2896	2710	2562	2422	2310
750,000	8929	5804	4066	3316	2876	2664	2306	2172	2032	1922	1816	1732
600,000	7142	4642	3254	2734	2300	2132	1846	1738	1626	1538	1454	1386
500,000	5952	3868	2710	2210	1916	1876	1538	1448	1354	1280	1210	1154
400,000	4762	3096	2168	1768	1534	1420	1230	1158	1084	1024	968	924
0000	2523	1640	1152	938	802	732	652	614	574	544	514	490
000	2006	1304	914	744	646	598	518	488	456	432	408	390
00	1592	834	724	592	512	474	412	388	362	342	324	308
0	1255	816	572	466	394	374	324	306	286	270	256	244
1	996	648	454	370	320	298	258	242	226	214	202	194
2	789	514	360	294	254	236	204	192	180	170	160	154

A positively effective method of protecting the aluminum from the action of the sea air would be to cover it with weather-proof insulation such as is commonly placed upon copper conductors, but as the area of the aluminum for equal resistance is 25 per cent. greater than that of copper, a proportionate increase in the amount of insulating material must be used, with a corresponding increase of cost, the net result of which would be to bring the cost of insulated aluminum higher than that of bare copper and practically equal to that of weather-proof covered copper. This question of the treatment or protection of aluminum conditions in the vicinity of salt water apparently remains for future solution.

On the other hand copper is liable to be detrimentally affected by atmospheres laden with acid fumes, consequently it would hardly be fair to condemn aluminum for lack of permanency any more than it would be to condemn copper. The most common impurity of aluminum is sodium, which forms a very unstable alloy, readily attacked and corroded in even slightly moist atmospheres. This defect, however, can be provided against by the manufacturers and no doubt the consumer can depend upon the purity of aluminum furnished by any responsible manufacturer as readily as he can depend upon the guaranteed qualities or characteristics of copper purchased from any responsible copper manufacturer.

It may seem that the statement made in the last paragraph that aluminum is not readily oxidizable, conflicts with the statement made in reference to the difficulty of soldering aluminum on account of the instant formation of a film of oxide on exposure of the freshly scraped aluminum surface, to the atmosphere. This is not the case, however, because after the thin film of oxide has formed upon the aluminum it seems to afford a coat or surface which effectively protects the aluminum from further oxidization. It is quite unlike iron in this respect because, as is well known, if the surface of iron be exposed to the action of the atmosphere or of moisture, the oxide of iron commonly known as rust forms and this action continues until eventually the entire piece of iron is destroyed, though this may take a very long time. I do not know whether this phenomenon is as yet clearly understood in respect of aluminum, but we have the fact before us that the protective coating forms as described.

Aluminum conductors were first placed on the market in the form of solid drawn wire and in this form a considerable quantity of it was installed on transmission lines. Subsequent experience has demonstrated that the tensile strength of any given aluminum conductor is increased somewhat by building it up of several smaller strands wound together, and since this form has been adopted the writer has not been able to learn of any instances in which the conductors have broken on account of deficient tensile strength where they have been properly installed.

EFFECT OF WIND PRESSURE.

A phenomenon which is of interest and may imply a significant fact of considerable importance in respect of the comparative effects of wind pressure upon aluminum and copper transmission lines was brought to the writer's attention by the perusal of a paper, by Mr. L. B. Stillwell, descriptive of the electrical transmission system of the Niagara Falls-Buffalo transmission plant, this paper being read by its author before the American Institute of Electrical Engineers in session at Buffalo, August 23rd, 1901. He refers to the behavior of the two transmission lines, one of which is equipped with 350,000 c.m. copper conductors, and the other with 500,000 c.m. aluminum conductors, the copper line having the poles spaced 70 feet, while the aluminum line has the poles spaced twice those of the copper, 140 feet. I take the liberty of quoting verbatim from Mr. Stillwell's paper (Vol. 18, Trans. A.I.E.E., 1901, p. 521):

"An interesting difference in the behavior of the old and new lines when the wind is blowing at high velocity has been observed. At such times the tightly strung copper conductors of the old line swing or vibrate irregularly, but on the whole rapidly, and the strain caused by this vibration is transmitted to the insulators, pins, cross-arms and poles in such a manner that the trembling of the pole may be detected by placing the hand against it at a point near the ground. Under similar circumstances, the aluminum conductors tend to assume a fixed position, which is sometimes apparently as much as 45 degrees from the vertical plane in which they hang when the air is quiet. There is practically no vibration perceptible at the pole. The elimination of vibrating strains upon the insulator and pin is gratifying, as in the old line the tendency of insulators to work loose from their pins has been noticeable and I have no doubt that it has been caused by the vibration of the conductors during heavy wind storms."

CONDUCTORS FOR WELLAND CANAL.

In connection with the installation of the electrical lighting and power distribution system along the Welland Canal, this work being now in progress, the Government has recently purchased a quantity of aluminum and copper conductors for the transmission and distributing circuits.

The writer's specifications called for Nos. 0, 2, 4, 6 and 10 B. & S. copper conductors, the No. 6 B. & S. to be medium hard-drawn and the No. 10 to be hard-drawn. Tenders were also taken as alternative, for the supply of aluminum conductors of resistances equivalent to those of copper conductors specified, and on comparing tenders it was found that the Nos. 3-0, 0 and 2 B. & S. aluminum conductors offered as equivalents for the Nos. 0, 2 and 4 copper would cost less than the copper, and the aluminum was purchased. The aluminum equivalent for No. 6 copper, taking into consideration the tensile strength specified for the medium hard-drawn copper, was found to be more expensive than the copper, consequently copper was purchased for the Nos. 6 and 10 gauges. The writer desires to explain that the gauge numbers just mentioned for the aluminum conductors do not represent the correct relative proportions as compared with copper, but are the nearest gauge numbers corresponding to the area of the aluminum conductors representing the copper equivalent.

The writer tested a proportion of the aluminum conductors for cross-section, tensile strength, torsion and resistance, and found the results given in the table below.

Approx. Gauge	No. of Strands	Appro. Gauge of Strands	Twists in 6 inches	Breaking Strains per sq. inch	Elongation in 6" per cent	Res. per 1000 ft. at 70° F.
000 B. & S.	7	7 B. & S.	21	29100 lbs.	2	.106
0 "	7	9 "	22	33000 "	2 2-3	.172
2 "	7	10 "	30	35500 "	3 1-3	.262

The above mentioned results of the tests seem to show that the tensile strength per square inch increases somewhat with a reduction in area of the smaller strands composing the conductor.

Also, it will be seen that the respective breaking strains of the aluminum, per square inch, exceed the breaking strain usually allowed for soft copper (pure), namely, 23,600 lbs., and in the Nos. 0 and 2 aluminum equal the breaking strain of medium hard-drawn copper.

ELECTRICAL CHARACTERISTICS.

The questions are often asked, with relation to alternating current work, as to the respective capacity, self-induction and skin effects of aluminum and copper.

As aluminum is one-quarter greater in diameter than equivalent copper, it is evident that the self-induction of the line will be the same when the aluminum wires are separated 25 per cent. more than the copper wires.

The static capacity of the aluminum will be approximately 5 per cent. greater than that of copper, with the same spacing.

The skin effect will be exactly the same with either of the two metals, since the effect of the greater diameter of the aluminum is exactly off-set by its greater specific resistance, in making the calculations for the per cent. increase of resistance.

All practical transmission lines possess sufficient excess of self-induction over capacity to cause a slight lag in alternating currents, and the power factor over an aluminum line would therefore be slightly better than that over a copper line, on account of the smaller self-induction and greater capacity. The difference is small, but what there is, is in favor of aluminum.

COMPARATIVE COST.

The market prices of aluminum and copper have always been such, for the past five years, that from 5 to 15 per cent can be saved by the purchase of aluminum. For instance, the present market price of copper is about 14 cents. An equivalent price of aluminum would be 29.8 cents, whereas aluminum can be had to-day for 27.5 cents, or the equivalent of 13-cent copper.

In view of all the facts, it would seem that we are no longer compelled to confine ourselves to a single material for carrying current as was formerly the case.

CONGRATULATIONS.

Referring to the Convention Number of the ELECTRICAL NEWS the Canadian Westinghouse Company, Limited, write: "We note the general excellence of the articles in this number, and wish to congratulate you on having gotten up such an exceedingly interesting publication."

FIRST-RATE AND MOST USEFUL.

Prof. C. A. Carus-Wilson, of London, Eng., formerly of McGill University, Montreal, in remitting his subscription adds: "The CANADIAN ELECTRICAL NEWS is first-rate and most useful.

The third annual report of the Montreal Light, Heat & Power Company shows that the gross revenue of the company during the past fiscal year amounted to $2,589,446.50, and the net profits to $884,013.85. During the year 34 501 incandescent, 155 commercial and 50 street lamps, and 210 motors, equivalent to 2,303 horse-power, were added to the company's circuits. There were installed during the year 2,895 gas and 983 electric meters, 1,949 gas stoves, and 1,091 new services and 12.01 miles of new mains and services were laid. There was a most gratifying increase in all branches of the electric department, and the prospects for additional business during the coming year are very bright.

LIST OF BRITISH FIRMS WANTING CANADIAN AGENTS.

Brooker & Goss, Ltd., mfrs. Electrical Instruments, Broad St. House London, E.C.

The Electrical & Ordinance Accessories Co., Ltd., Birmingham, Electrical Supplies.

Rhodes Electrical Mfg. Co., Ltd., 70 Bishopsgate St., London, E.C.

W. F. Dixon & Co., Manchester, Mfgs. Raw Hide Silent Gears.

Veritys Limited, King St., London, W. C., Electrical Supplies.

Johnson & Phillips, Union Court, London, E.C., Electrical Instruments, Lamps and Supplies.

Nalder Bros. & Thompson, Ltd., Queen Street, London, E.C., Electrical Instruments.

Canadian firms in a position to handle successfully the goods of any of the above British exporters should communicate with them direct, mentioning the CANADIAN ELECTRICAL NEWS.

TEST OF THE NERNST LAMP.

A test was recently made by the Philadelphia Electric Company in their laboratory for the purpose of demonstrating the stability of the Nernst lamp before certain officials of the Pennsylvania Railroad Company. The report of the results gives the following particulars :

A 6 glower, 210 volt Nernst lamp was supplied with new ballasts, heaters and glowers, and connected in circuit by Mr. James D. Brooke, of the Nernst Lamp Company.

The energy consumed by the heaters only, when the lamp was connected to a circuit of its normal rated voltage, namely, 210 volts, was 280 watts.

The voltage was increased in steps of 10 volts, and the amount of energy consumed by the lamp at start and after burning five minutes was as follows :

Volts	Watts at Start	Watts at end of 5 minutes	Per Cent. Increase
210	582.4	588.	0.
220	649.6	630.	4.7
230	683.2	652.4	9.5
240	728.	694.4	14.3
250	784.	767.2	19.
260	896.	896.	23.8
266	994.		26.6

After the voltage was increased to 240 volts the ballasts showed signs of deterioration and started to blacken slightly.

After the voltage was increased to 250 volts the centre ballasts were a deep black color with a blue tinge.

After the voltage was increased to 260 volts the ballasts were so hot that the glass bulged, and the ballast wires were badly distorted. All of the ballasts were very black, but the glowers were in good condition. The wire in one ballast broke after being in circuit four minutes, another broke at the end of the fifth minute, two more at the end of the sixth minute. The two outside ballasts broke at the end of eight and one-half minutes. When the fifth ballast broke the heaters all cut in on one glower.

Further tests were made by burning the lamp at its normal rated voltage and then subjecting it to an instantaneous increase in voltage, with the following results :

CONDITION No. 1.—The lamp was then supplied with new ballasts and started at 210 volts, and after the heaters were automatically cut out and the lamp burning under normal conditions, the voltage at the lamp terminals was increased instantaneously to 250 volts or a 19°/o increase. The ballasts showed no signs of deterioration.

CONDITION No. 2.-The lamp was started at its normal rated voltage and then the voltage at the terminals of the lamp was increased instantaneously to 360 volts or a 71.4°/o increase. The ballasts were open circuited. The same ballasts, heaters and glowers were used as in "Condition 1."

CONDITION No. 3.-The lamp was then supplied with new ballasts only. It was started at its normal rated voltage, and then the voltage at the terminals of the lamp was increased instantaneously to 300 volts or a 42.8°/o increase. The ballasts showed no sign of deterioration.

CONDITION No. 4.—The lamp was then started at its normal rated voltage and the voltage at the terminals of the lamp was increased instantaneously to 315 volts or a 50% increase. The ballasts shoowed no signs of deterioration. The same ballasts, heaters and glowers were used as in "Condition No. 3."

CONDITION No. 5.—The lamp was started at its normal rated voltage. The voltage at the terminals of the lamp was then increased instantaneously to 325 volts or a 54.7% increase. The same ballasts, heaters and glowers were used as in "Conditions No. 3 and No. 4." The ballasts were all open circuited and have a slight dark tinge.

CONDITION No. 6.—The lamp was then supplied with new glowers, heaters and ballasts complete. The lamp was started at its normal rated voltage. The voltage at the terminals of the lamp was then increased instantaneously to 325 volts or a 54.7 increase. (The same as "Condition No. 5.")

MOONLIGHT SCHEDULE FOR AUGUST.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Aug. 1	7 50	Aug. 1	11 30	3 40
2	7 50	3	0 00	4 10
3	7 50	4	0 30	4 40
4	7 50	5	1 00	5 10
5	7 40	6	1 45	6 05
6	7 40	7	2 30	6 50
7	7 40	8	3 30	7 50
8	7 40	9	4 10	8 30
9	7 40	10	4 10	8 30
10	7 30	11	4 20	8 50
11	7 30	12	4 20	8 50
12	7 30	13	4 20	8 50
13	7 30	14	4 20	8 50
14	7 30	15	4 20	8 50
15	7 30	16	4 20	8 50
16	7 30	17	4 20	8 50
17	7 30	18	4 20	8 50
18	10 00	19	4 20	6 20
19	11 00	20	4 20	5 20
20	11 45	21	4 20	4 35
22	0 40	22	4 30	3 50
2	1 30	23	4 30	3 00
24	2 30	24	4 30	2 00
25	No Light	25	No Light	....
26	"	26	"	....
27	"	27	"	....
28	7 10	28	9 30	2 20
29	7 10	29	10 00	2 50
30	7 10	30	10 30	3 20
31	7 00	31	11 00	4 00
			Total............	163 40

POWER TRANSFORMERS.

The Pittsburgh Transformer Company desire to call attention to their power transmission transformers. The company states that these transformers are designed with especial care to secure a flow of oil through the windings of the transformer. A thermometer may be lowered between any pair of coils and passed entirely through the transformer, thus making temperature measurements to be made directly and quickly. These coil openings have such a pronounced flue effect that the convection currents set up in the oil produce a visible disturbance on the surface. In consequence of this rapid oil circulation through the windings the temperature rise is not only very moderate, but what is even more important, the interior parts are but slightly warmer than the external portions.

ENGINEERING and MECHANICS

COMPARATIVE BOILER TESTS WITH ORDINARY AND PULVERIZED COAL FIRING.

In one of the boiler rooms of the McCormick works of the International Harvester Company, at Chicago, two tests were conducted on February 2 and 3, to determine the relative performance of the boilers when equipped for machine firing of coal dust and when operated in the usual way with hand firing. Two boilers were selected and the pulverized coal test made on the first day and the hand-firing test on the second, each of 8 hours' duration and under as near as possible the same conditions. The trials were made under the direction of Mr. C. C. Smith, chief engineer of the works.

Each of the boilers was a Babcock & Wilcox water-tube steam generator, having a traight grate, 63 4-inch tubes 18 feet long, one 36-inch drum, a total heating surface of 1,200 square feet and a grate surface of 4.5x7 = 31.5 square feet. The system of powdered coal burning employed was that developed by the C. O. Bartlett & Snow Company, of Cleveland. Illinosicoal screenings were burned in both tests, pulverized 40-mesh fine for the dust-burning test. The data and results are given in the accompanying table.

The cost of evaporation may be calculated from the figures in the table. Assuming coal delivered into the boiler room at $1.72 per ton of 2,000 pounds, it will be found that the cost of evaporating 1,000 pounds of water from and at 212 degrees Fahr. is 17.7 cents; with the pulverized coal costing $2.10 per ton, the cost of 1,000 pounds of steam uuder the same conditions is 14.55 cents. As a figure of interest, it is said at the works that it costs 19 cents per ton to dry and pulverize the coal. The heating value of the powdered coal was found to be 12,555 British thermal units per pound, so that the latent heat of vaporization being 965.8, the theoretical possible evaporation is 13 pounds per pound of coal. The actual equivalent evaporation being 7.21, the efficiency is 7.21 ÷ 13 = .555 or 55.5 per cent. The coal used in the hand-fired test gave 11,300 thermal units per pound, corresponding to 11.7 pounds best possible evaporation, and, the actual evaporation being 4.86, an efficiency of 41.5 per cent.

The difference between the two unit figures tabulated for evaporation per pound of fuel is 2.22, which is 48.4 per cent. of the evaporation based on fuel actually used in the hand-firing test, or an increase of evaporation of 48.4 per cent. in favor of the pulverized coal. The difference in the boiler capacity in the two cases is 88.4 horse-power, or an increase of 53 per cent. To determine the coal saving, 570 pounds, or 71¼ pounds per hour, were added to the actual consumption of pulverized coal to equalize for the greater amount of moisture in the hand-fired coal, so that to evaporate 8,283 pounds of water per water, the pulverized system was changed in the report with 1,285 pounds of coal. The hand-fired method requiring 1,175 pounds of coal to evaporate 5,399 pounds of water per hour would require 1,803 pounds to evaporate 8,283 pounds of water, or 518 pounds more than charged to the pulverized system. This is about 29 per cent. ot 1,803, indicating a coal saving of that amount with equal amounts of evaporation. In short the tests show with the same amount of coal an increase of evaporation ot 48.4 per cent. or with the same evaporation a saving in coal of 29 per cent.

RESULTS OF THE COMPARATIVE COAL-FIRING TESTS.

	Pulverized coal.	Hand firing.
Coal per hour, lbs	1,214.1	1,175
Coal per hr. per sq. ft. grate, lbs	19.27	18.65
Water per hour, lbs	8,283.1	5,399.1
Equiv. evapn. per hr., lbs*	8.758,8	5,709.1
Equiv. evapn. per hr. per sq. ft. htg. surf., lbs.*	3.65	2.38
Boiler pressure, lbs	79.8	79.4
Feed water, deg. F	169.7	172.1
Flue gases, deg. F	506	458.3
Draft, ins. water	0.52	0.42
H.-P. developed	253.9	165.5
Per cent. of bldrs. rating	105.83	68.9
Water per lb. fuel, lbs	6.82	4.6
Equiv. evapn. per lb. fuel, lbs	7.21	4.86
Equiv. evapn. per lb. dry coal, lbs	7.48	5.43
Equiv. evapn. per lb. comb., lbs	9.13	6.94
Analysis of coal—		
Moisture, per cent	3.5	9.36
Volatile, per cent	32.3	31.1
Fixed carbon, per cent	46.7	40
Ash, per cent	17.5	19.54
Analysis of ash—		
Volatile, per cent	2.74	8.8
Fixed carbon, per cent	1.78	25.52
Ash, per cent	95.48	65.68
Flue gases—		
Carbonic acid, per cent	5.4	4.4
Oxygen, per cent	14.6	16
Carbonic oxide, per cent	.....	.....
Nitrogen, per cent	80	79.6

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*Corrected for moisture, which was assumed at 2 per cent.

As a matter of further interest the report states that the furnace was practically smokeless, with the pulverized system in operation, while considerable smoke was produced during the hand-fired test. In the test with the pulverized firing, a small amount of fine dust, ashes, fell off the tubes, a bright red light showed through the bars, there was a light bed ot clinkers, 1 inch thick, used on test, which were not fused, and there was a light dust on tubes, but no soot and no appreciable fusion on outside of tubes. The fires were cleaned three times during the hand-fired test and a small amount of clinkers and soot was found on the tubes.—Engineering Record.

STEAM BOILER INSPECTION.

At the last session of the British Columbia Legislature some important amendments were made to the Steam Boiler Inspection Act. Under the original Act the work which might be undertaken by a third-class engineer was limited to the taking charge of a steam plant of not more than 250-horse power or of any steam fire engine, provided the engines, in the former case, were not compound engines, though he might act as second or assistant engineer of any steam plant up to 500 horse-power and where simple high pressure was used. This was modified in 1902 by allowing third-class engineers to act as assistants on any steam plant of not more than 500 horse-power, or on any steam plant where simple high pressure engines were used. By the alteration recently effected a third-class engineer is permitted to take charge not only of any simple high pressure steam plant of not more thar

250 horse-power, or of any steam fire engine, but also of any compound condensing steam plant up to 150 horse-power, and he is qualified now as well to act as second or assistant engineer on any steam plant where high pressure engines are used, or where a compound condensing steam plant is used up to 500 horse power.

In the classification of engineers an addition was made in 1902 to the original number of grades, by which "engineers with service certificates" were added in two subdivisions, namely, series 1 and series 2. These subdivisions are now done away with, and there are a number of alterations made in the provisions relating to this class of engineers. An engineer with a certificate of service is now qualified, when in possession of a certificate of service given without examination, to act as a second or third-class engineer, as if he were in possession of a certificate of competency of a similar grade. The qualifications for a service certificate are as follows :—He must have been in charge of a steam plant (or of a watch) for five years preceding the passage of the Act. For a second-class certificate he must have been in charge of a steam plant or watch where the actual horse-power is not less than 150 ; for a third-class certificate the horse-power is reduced to 25; for a fourth-class certificate it is simply stated that the applicant must have been in charge of a steam plant of any kind.

C. A. S. E. OFFICERS.

At the last regular meeting of Toronto No. 1, Canadian Association Stationary Engineers, the following officers were elected for the ensuing year :—President, W. L. Oathwaite ; Vice-President, W. McGhie ; Recording Secretary, H. E. Terry ; Financial Secretary, W. J. Webb ; Treasurer, Chas. Moseley ; Conductor, W. H. Smith ; Doorkeeper, W S. Butler ; Delegates to Executive Convention, W. J. Webb, Geo. Thompson, W. L. Oathwaite, Geo. C. Mooring ; Trustees, J. Dixon, Geo. Thompson, N. V. Kuhlman.

ENGINEERING NOTES.

The charge for electric power from the water power at Schaffhausen, Switzerland, is 3.86 cents per kilowatt-hour, with a minimum of $9.65 per year per kilowatt capacity.

A power gas plant at the Embrach Pottery, Switzerland, ran 8,235 hours during 1903, developed 355,233 kilowatt-hours and consumed 1.56 pounds of coal per kilowatt-hour, or 0.99 pound per horse-power-hour, according to the "Schweizerische Bauzeitung." The plant includes three 250-horse-power gas generators and three 100-horse-power gas engines.

Elastic foundations for steam hammers, high-speed engines and other machinery have been made in Germany for some time by using impregnated felt sheets through which vibrations will not be transmitted. The material is now being introduced in England by the Patent Woolen Cloth Company, Elmwood Mills, Leeds, for the same purpose and also in bridge construction where it is essential to keep the vibration of passing trains from reaching adjoining property. The material is stated to be a pure wool felt made in strips up to 60 inches in width and 1½ inches in thickness. It is impregnated with mineral fats and its upper surface subjected to a sort of preservative process to resist dampness.

Oil separation by electricity has been accomplished by Messrs. Davis & Perritt, of London, according to the "Electrical Engineer." The water is passed through a wooden tank 12 feet long, 30 inches wide and 27 inches deep, and flows in parallel streams through three compartments into which the tank has been divided. The flow of water takes place between iron electrodes, maintained at 50 volts potential between adjacent plates, or 150 volts across the three in series. When the plant was handling 2,000 to 3,000 gallons of water hourly it is said that a reduction of 1.07 to 0.01 grain of oil per gallon was affected with apparently 20 amperes.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, July 7, 1904.

The electrical trade in Montreal still continues to be quiet, and there appears little prospects of any great activity this season. The run of business usually expected at this time of the year has fallen very flat and there are comparatively few enquiries for electric installations.

The quantity of tape used for electricial purposes in Canada must total up to a fine bulk, yet it is noticeable that by far the largest amount is imported from the States, notwithstanding the existing duty. To the casual observer it would appear an easy matter to meet this demand by Canadian manufactories. Canada has some fine rubber factories equal in every way to our American cousins, yet the users tell us that they must buy imported tapes, home tapes are no use, Canadian manufacturers cannot or will not compete for quality—a truly remarkable state of things.

The Montreal Electric Company are just at the point of finishing the wiring of the sheds and wharves on the water front, a large contract.

Mr. Howes, representing the Electric Gas Lighting Company, of Boston, was a visitor to Montreal last month, on his usual business trip.

Mr. Geo. H. Hill, lately of the Hill Electric Switch Company, of this city, has withdrawn from electrical affairs and settled down on a farm which he has recently purchased in the district of Lacolle, P.Q. Mr. Hill will endeavor to turn to practical uses his old hobby of raising poultry and fruit. It would not surprise us much, however, if he returned later to his old love "Electricity." Once a man has put his hand to the electrical plow it would seem from the experience of others that it is hard to give it up.

Years ago in the Old Country there existed a tax on windows, which happily has long since been repealed. The Montreal City Council, however, have lately gone one better by putting a tax on electric motors. Just why has not been reasonably explained by any alderman or official except that "we need the money." The original proposal was $5.00 per motor, which on some establishments using a number of small motors would have meant an exodus outside of city limits. A deputation consisting of Mr. Cooper, Secretary Canadian Manufacturers' Association, Mr. McGill, Mr. Bailey and Messrs. Walbank and Wilson, of the Montreal Light, Heat & Power Company, and Mr. W. B. Shaw, of the Montreal Electric Company, waited upon the finance committee and succeeded in part in securing an amendment more reasonable. The amendment proposed by Ald. Ames was $5.00 per establishment using motors aggregating five h.p. or over, and $2.00 for less than 5 h.p. The amendment has, of course, to come before the City Council as yet. Special thanks are due Ald. Sadler for his presentation of the case. He has always shown his appreciation of electrical industries and tries to secure them fair play. It was to be regretted that the question came up as it did when so many of the electrical fraternity were away at the Hamilton convention.

"RENEWED" INCANDESCENT LAMPS.

Comparatively few persons know why an electric lighting company is so exceedingly kind to its customers as to give them new incandescent lamps without charge in exchange for those which have been burned out. The employees are always so polite, almost anxious to make the exchange. Anyone can find out the reason by burning new high priced incandescent lamps for a month, and the next month the lamps the company gives in return for old ones. His bill will show that the reason, from the company's point of view, is an excellent one. The lamps supplied by the companies are invariably "renewed" lamps, that is to say, old lamps made new by a delicate but inexpensive process, and "renewed" lamps burn more current—much more. The Millennium is not yet here.—N. Y. Evening Post.

Messrs. C. W. Bongard & Company, 52 Adelaide street west, Toronto, have been appointed western representatives for the Wire and Cable Company, of Montreal, and will carry a complete stock of their various lines of copper wires and cables.

PERSONAL.

Mr. O. B. Suhr, chief engineer Ontario Power Co., Niagara Falls, Ont., has been elected a member of the American Society of Civil Engineers.

Mr. W. J. Camp, chief electrical engineer for the C.P.R. Telegraphs, attended the recent convention of Railway Telegraph Superintendents at Indianapolis.

Mr. E. E. Ewart, for several years superintendent of the Cranbrook Electric Light Company, Cranbrook, B.C., has resigned to accept a position in Portland, Oregon.

Mr. C. H. Hines, chief electrical engineer for the Canadian Pacific Railway, has tendered his resignation, and left on June 18 for South America, where he will assume the management of a large electric plant.

Mr. Cecil B. Smith, resident engineer at Niagara Falls for the Canadian Niagara Power Company, has appointed Mr. Charles C. Egbert as assistant mechanical engineer to superintend the installation of the 10,000 horse power turbines to be installed in the power plant.

The death occurred in Hamilton recently of Mr. Richard Fuller, who obtained the contract from the Mackenzie Government for constructing a large section of the C.P.R. telegraph lines. He built the system from Edmonton to Fort Qu'Appelle, and is said to have made considerable money on the contract. Later he became president of the Keewatin Power Company and a director of the Great North-Western Telegraph Company. He was 76 years of age.

PUBLICATIONS.

The Abner Doble Company, San Francisco, Cal., have issued an attractive booklet referring to tangential water wheels.

The booklet describing and illustrating the works of the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., is one of the most attractive examples of the printer's art which has come to our notice. The illustrations are excellent.

The fourth edition of a manual for engineers has been issued by the University Press, Knoxville, Tenn. While the primary object of the book is to bring to the attention of men the value of technical training in schools and colleges, it contains much information in a most convenient form of great value to engineers. The price of the book is 50 cents.

The H. W. Johns-Manville Company, New York, have just issued a neat and complete catalogue covering "mica" plate, cloth, segments, rings and mica in all its various forms required by the electrical industry, also "Vulcabeston," "Transite," "Electrobestos" and "Niagrite." A copy can be had by addressing them, 100 William street, New York.

The Canadian General Electric Company have recently issued a bulletin of more than ordinary interest. It refers to the Meridian lamp, which is a combination of a properly designed incandescent lamp with a suitable reflector and ornamental holder detachable from the lamp. The lamp filament is of special shape and accurately located in the bulb with reference to the reflector.

SPARKS.

Eastern capitalists are considering the construction of an electric street railway at Calgary, N.W.T.

The Hamilton, Grimsby and Beamsville Electric Railway has passed into the control of the Grand Trunk Railway Company.

The Dartmouth Electric Light Company, Dartmouth, N.S., are building a new power house, in which a modern plant will be installed.

The Electrical Development Company have just awarded to the Canadian General Electric Company the contract for six generators of 7,500 kilowatts capacity each for their power plant at Niagara Falls, Ont.

The Packard Electric Company, Limited, of St. Catharines, Ont., has permanently located its north-western branch at No. 41 Canada Life Building, Winnipeg, where their representative, Mr. G. A. Powell, will be able to better care for the growing interests of the company in the North-west.

The cost of thawing water pipes by electricity, according to figures given at the recent meeting of the National Electric Light Association, was as follows on the basis of 125 house services thawed in Rutland, Vt., during February: On the average, 17 amperes alternating current at 2,200 volts were required and the average time consumed was 27 minutes. At 10 cents per kilowatt hour the current cost was $1.68; and the cost of labor was $1.85 and of teams and drivers 58 cents, making the total cost per service $4.11.

The annual meeting of the New Brunswick Telephone Company was held at Fredericton, N.B., June 14th, at which encouraging reports were submitted and the usual half-yearly dividend declared. It was decided to erect new exchange buildings at Moncton and Fredericton in the near future. The work of extending the line from Grand Falls to Edmundston will be carried out immediately. The directors for the current year are: President, Hon. A. G. Blair; vice-president, Joseph L. Blake; secretary, W. E. Smith; managing director and treasurer, Senator Thompson.

That the products of the Packard Electric Company, of St. Catharines, Ont., are demanding their share of the public patronage is noteworthy, in view of the fact that the company has been compelled to completely rearrange and remodel their great plant at St. Catharines in order to keep apace with the growing business that the firm enjoys. When the alterations are completed it is said the Packard Electric Company will have as fine facilities for manufacturing lamps, transformers and meters—the three lines in which they specialize—that modern manufacturing science can devise.

The Mexican Light and Power Company, Limited, Montreal, of which Mr. James Ross is president, are announced to have just placed the largest single order for copper cable ever awarded in the United States. The contract calls for 1,500 miles of copper cable, weighing upwards of 2,000 tons. It is for the purpose of transmitting electric power from the company's Necaxa power plant to Mexico city, thence to El Oro mining district, a total of some 125 miles. The line will be supported on steel towers in spans of 500 feet. The Ansonia Brass & Copper Company, of Ansonia, Conn., were the tenderers.

Toronto and Montreal capitalists, including Hon. George A. Cox, Frederic Nicholls, F. S. Pearson and Sir William Van Horne, have organized the Rio de Janeiro Light & Power Company, Limited, with a capital of $50,000,000. The company is said to have secured a monopoly of the electric business in the city of Rio de Janeiro, Brazil, having secured the only important water power adjacent to the city. The existing power and lighting companies and four tramway companies have also been purchased. At the outset the company will issue $25,000,000 bonds, which will provide for the purchase of the properties and give a working capital of $2,000,000.

The British Columbia Electric Railway Company have adopted a new schedule of wages applying to the system as operated in Victoria, Vancouver and New Westminster. Motormen, conductors and car maintenance men will be paid under the following schedule: For first six months in service, 20c. per hours; next six months, 21c.; second year, 22c.; third year, 23c.; fourth and fifth years, 24c.; sixth and seventh years, 25c.; eighth and ninth and tenth years, 26c.; after tenth year, 27c. Trackmen will be paid as follows: First year, 20c.; after first year, 22c. The increased rate to the car men was advanced on July 1st, 1902, also. Previous to that the rates paid were 20c., 21c., and 22c. In 1902 the first year's pay was made 20c.; second and third year, 22c.; fourth and fifth years, 23c.; and after fifth year, 25c.

The development of the water power at Port Severn, Ont., is now being taken up, and preliminary estimates will be asked for in the near future. The site presents no serious engineering difficulties, and it is hoped that the plant will have reached an advanced stage before the end of the present year. The dams, which are now in place, give a working head of twelve feet, and there is sufficient water available to supply the needs of the various towns for many years to come. Power will be transmitted to Waubaushene, Fesserton, Coldwater, Victoria Harbor, Midland, and perhaps Penetang, requiring in all some 25 miles of line. The initial installation will have a capacity of about 500 kilowatts, and this will be added to as rapidly as the demands require. The Electrical Supervision Society, of Toronto, has charge of the work.

WANTED—10 or 15 4 Amp. series Arc Lamps new or second hand. R. C. McLeay, Watford, Ont.

FOR SALE

One 180 k. w. 1100 or 2200 volt two-phase 16000 alternation S K.C. Inductor type Generator, complete with marble switchboard, station instruments and 4-pole exciter; apparatus good as new;

Two 60 k.w. 1100 volt 16000 alternation single-phase Canadian General Alternators, with exciters; in good working order. Apply Box 99 ELECTRICAL NEWS, Toronto, Ont.

SPARKS.

Farnham & Turner, telephones, etc., Dunham, Que., have dissolved.

Mr. Farlton Rouse, electrician, of Lowell, Mass., was drowned at North Hatley, Que., on June 23rd by the upsetting of a canoe.

Mr. W. H. Breithaupt, of Berlin, Ont., announces that the Bridgeport and Berlin Street Railway will be extended to Bloomingdale, and that in the near future application will be made for a charter for an electric road from Bloomingdale north as far as Elora.

The British Columbia Foundry & Engineering Works, Limited, are building extensive works at Esquimalt, B.C., which will be operated by electricity.

The Calgary Water Power Company, Calgary, N.W.T., have secured a renewal contract for street lighting in that town. They will supply 65 lights of 1,200 c.p. each.

Mr. A. J. Mott, of Fernie, B.C., who is interested in the Elk River Power and Light Company, states that surveys for a power plant at Elko will be made immediately, and that plenty of capital has been secured to carry out the work.

The Q. & C. Bonzano Rail Joint Company, Limited, recently organized, purpose building a large factory in Montreal.

The Cranbrook Electric Light Company, Cranbrook, B.C., are preparing to extend their telephone system to Moyie and Wardner.

An effort is being made to induce the Halifax Tramway Company to extend their line through Dutch Village. This portion of the city is rapidly growing in importance.

The Martin Electric Supply & Construction Company, St. Catharines, Ont., have been awarded the contract of installing an electric plant of 150 lights in the Aylmer Canning Company's factory at Aylmer, Ont.

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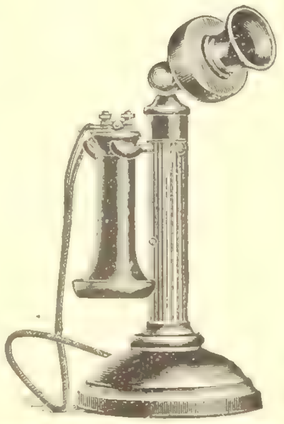

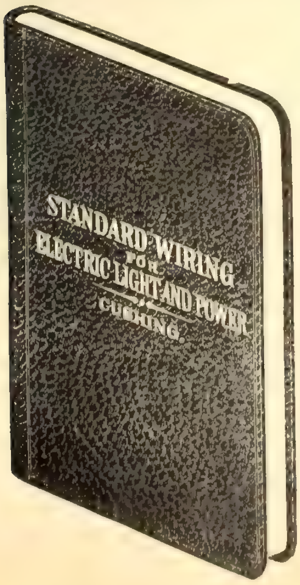

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TRADE NOTES.

The Westinghouse Companies at the Louisiana Purchase Exposition extend a cordial invitation to the electrical fraternity to visit their headquarters in the Palace of Machinery and their further exhibit in the Palace of Electricity and the Palace of Transportation at the World's Fair, St. Louis.

The Robb Engineering Company, of Amherst, N. S., have closed a contract for a large engine for belting direct to a generator for furnishing light and power on a large sugar plantation at Mayaguez, Porto Rico. It is understood that the contract was secured in competition with the leading United States firms.

The Canadian Westinghouse Company, Limited, of Hamilton, Ont., have recently closed a contract to furnish the Shawinigan Water & Power Company, Shawinigan Falls, P.Q., with a 6,600 k.w. two-phase, 2,200 volt, 3,600 alternations, 180 r.p.m. rotating field alternator, for direct connection with water wheel. Two 2,200 k.w., oil insulated water cooled transformers, 2,200 volt primary, 50,000 volt secondary, are included in this contract.

The Pittsburg Transformer Company state that they have what is probably the most complete mailing list of electric light interests in Canada. Each month the Pretty Girl calendar and bulletin for the month are distributed over this list. The company wish to ask if any one interested in electric lighing or power transmission fail to receive a copy of these each month, for if so their names will be added to their mailing list on request. To avoid mistakes send letters on your company's letter-head or enclose business card.

The Penberthy Injector Company, of Windsor, Ont., intend having a process exhibition at the Dominion Exhibition to be held in Winnipeg. They will send their sales-manager, Mr. E. Burton Kelly, to have charge of the booth and will also send one of the best lathe hands, who will perform the machine operations necessary to complete "Penberthy" injectors. This should be of considerable interest to threshermen and engineers—in fact, to anyone who has never been inside a brass shop. They will also send up some very attractive display stands of brass goods and expect to have a first-class exhibit.

A proposition is being discussed by prominent business men of Moosomin, Arcola and Alameda, N.W.T., to construct an electric railway connecting these points and touching Fish lake and other summer resorts. It is proposed to carry freight as well as passengers, and the promoters have in view the supplying of light and power for the municipalities.

The Montreal Light, Heat & Power Company have been given the exclusive right for twenty years to supply light in the municipality of St. Louis. The lights are to be placed where the town engineer directs, at a cost $75 per lamp per year.

The RICHMONDT CONDUIT & MFG. CO., Limited
Sole Manufacturers of
Richmondt Electro-Galvanized and Navalite Conduit Tubing and Fittings
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NEW TELEPHONE LINE

A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates :

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Diploma and Medal Awarded "World's Fair" Chicago, 1893.

SPARKS.

A new electric light plant has been installed at Liverpool, N.S. The generators are 225 kilowatts capacity each.

The electric light plant at Chatham, N.B., is loaded to its full capacity and may be enlarged at an early date.

The ratepayers of Thamesville, Ont., will vote on a by-law on July 11th to raise $6,500 to purchase the electric light plant.

Mr. A. R. McDonald, managing director of the Quebec Power & Electric Company, has purchased the St. Anne Falls water power. This purchase gives the company control of all the water power in the Quebec district.

Mr. J. H. Holton, of Boslington, Vermont, was in Owen Sound, Ont., recently looking into the prospects for the construction and operation of an electric railway in that town and vicinity. He is said to have been well pleased as a result of his investigations.

The net profits of the St. John Street Railway Company, St. John, N.B., for the year ended 30th of April last were $50,053 63, out of which two half-yearly dividends of three per cent. were declared, leaving a balance of $13,817.83, which was transferred to the profit and loss account. The company are now making extensive improvements to their power plant and lines. Officers for the current year have been elected as follows: President, James Ross; vice-president, J. M. Robinson; secretary-treasurer, W. Z. Earle.

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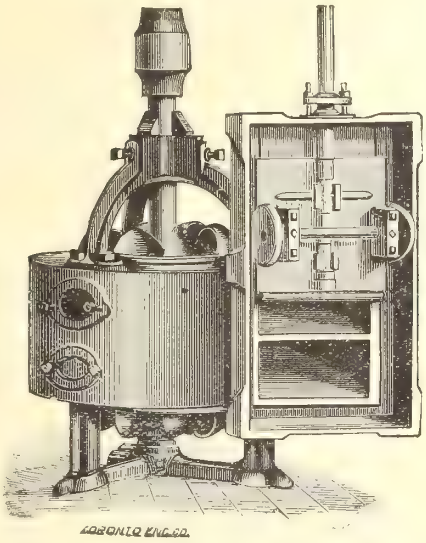
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SPARKS.

The Bell Telephone Company have installed a new switch-board in their exchange at Port Colborne, Ont.

The Toronto and Niagara Power Company have just awarded the contract for the erection of a large fireproof sub-station on the Davenport road adjacent to the limits of the City of Toronto.

According to a special report recently brought down, the Dominion Government own 6,042 miles of telegraph lines and 348 miles of cable. The average yearly number of messages sent is 96,500, of which the Yukon line carries 24,000.

The Cape Breton Electric Company operate 15 arc lights and 168 incandescent lights on the streets of Glace Bay, N.S. The are 12,316 lights installed in buildings and the company have 120 miles of overhead wire. The Eastern Telephone Company have 470 telephones in use in the town, and recently the long distance system has been completed to Halifax and St. John.

WANTED

An Engineer, having first class license, one competent to operate boiler plant and 200 horse power tandem compound condensing Robb Engine, direct connected to alternating current generator. Must have A1 references and be competent to make ordinary repairs and keep plant in first class condition. Address FRED MACKERACHER, Town Clerk, Pictou, Nova Scotia

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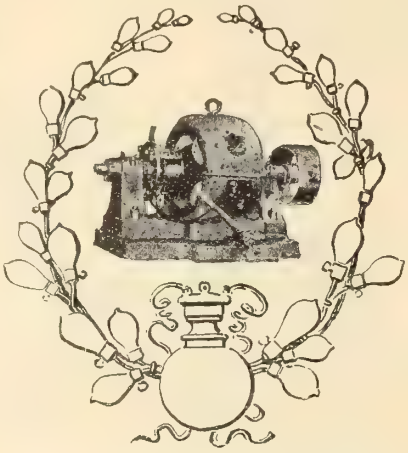

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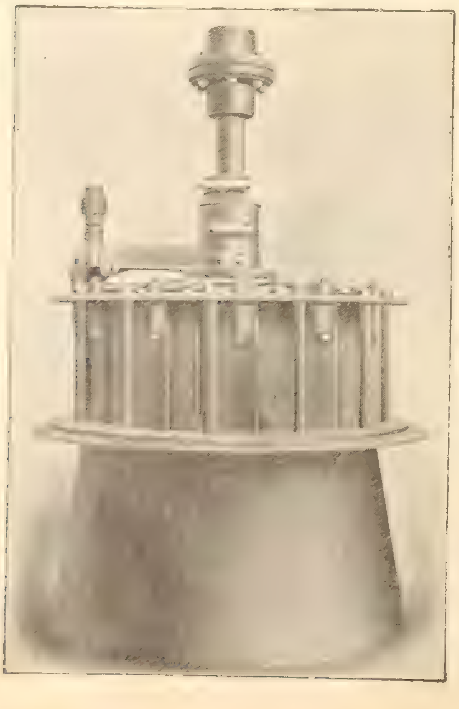

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SPARKS.

The International Electric Company, Montreal, have registered their business.

The Weyburn Telephone Company has been organized by Messrs. Oscarson and Simpson, to construct a telephone system at Weyburn, N.W.T., and extending to Regina.

The Standard Construction Company, Montreal, are installing an electric plant, including switchboards and motors for elevators and laundry work, for the Reverend Sisters of Hotel Dieu.

The Sovereign Oil Company, Limited, has recently been organized to conduct a general oil business. The capital is $50,000, and the head office will be at Comber, Ont. Mr. John C. Winters, of Mount Morris, N.Y., and Mr. W. J. Ainslie, of Comber, are directors of the company.

Mr. J. Burtt Morgan, who has organized the Chilliwack Power and Light Company, Chilliwack, B.C., proposes to expend $100,000 in developing electric power on the Chilliwack river, about six miles from the town. Messrs. Hermon and Burwell, consulting engineers, of Vancouver, have made a preliminary report upon the property and will draw up a general scheme for construction. Several contracts for light and power have already been secured, and in addition the company have a tramway line in view.

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Young Man (twenty-five), manager of power, lighting and waterworks plant, wishes change of locality. Practical electrician, also familiar with general business details in connection with plants. Would take any position where promotion offered merit. Address "Superintendent," care of CANADIAN ELECTRICAL NEWS, Toronto

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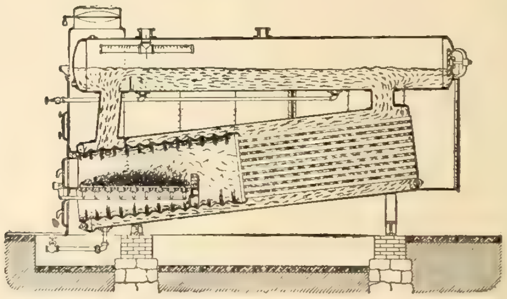

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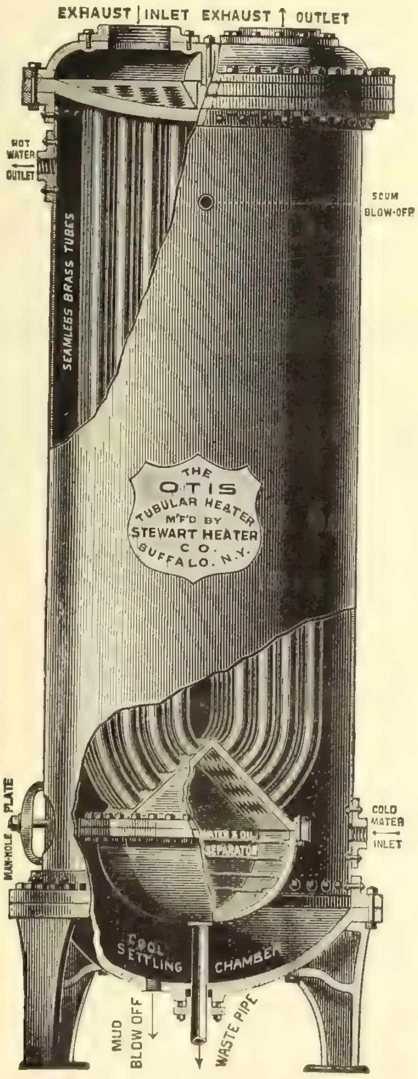

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THE STEWART HEATER CO.

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BUFFALO, N. Y.

SPARKS.

The city, of Sherbrooke, Que., is still wrestling with the lighting problem, the council having recently decided to submit a by-law to the ratepayers to raise $200,000 for the purchase of a plant to be under civic control.

Messrs. W. Moore & Sons, proprietors of the Meaford Rolling Mills, Meaford, Ont., who are developing a water power about a mile from the town, have 55 feet head, giving about 800 horse power, with possibilities of 85 feet. They will shortly commence the construction of a power house.

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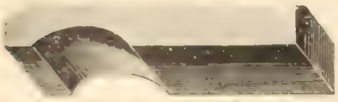

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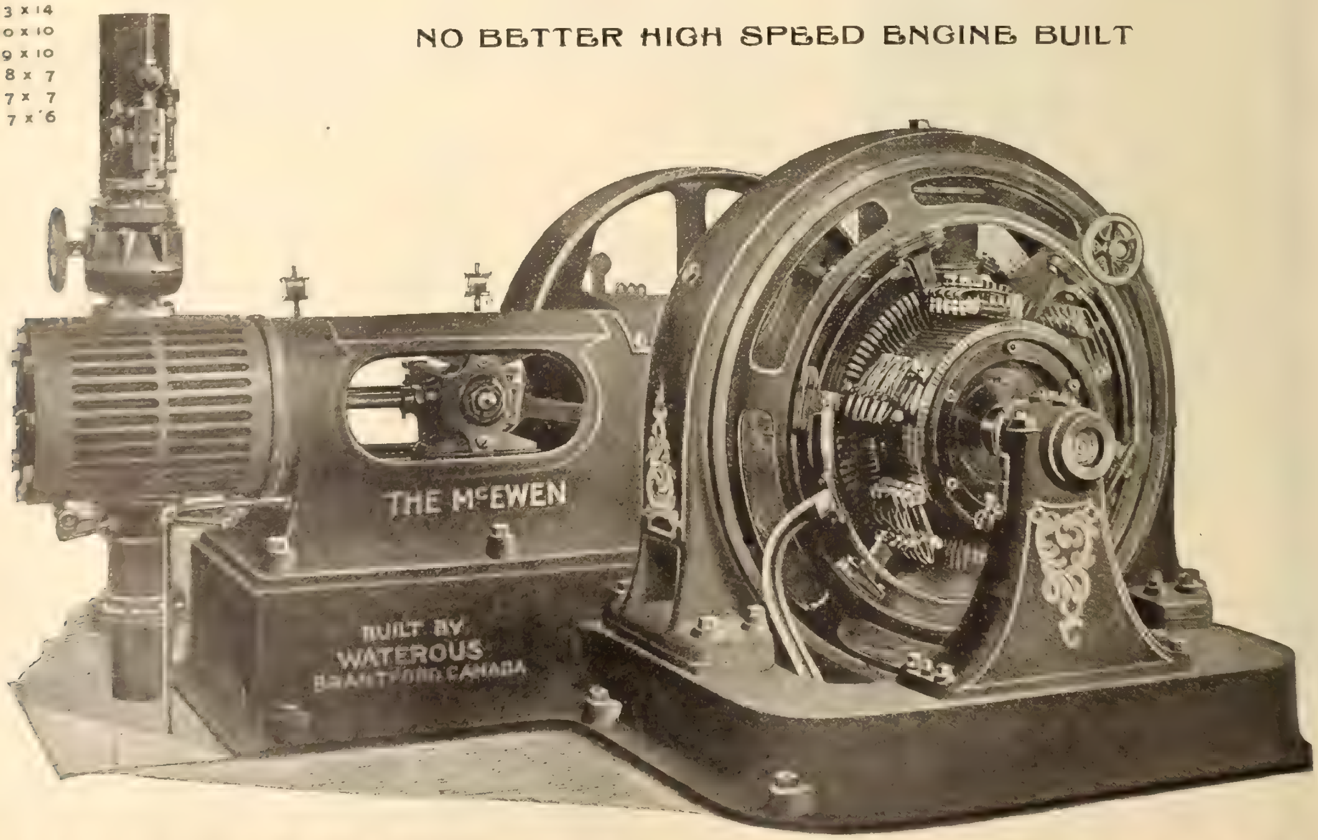

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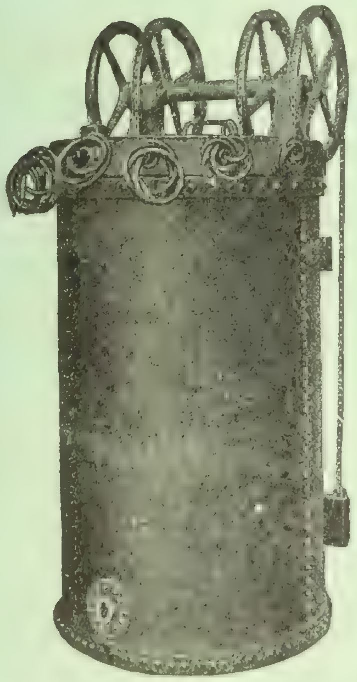

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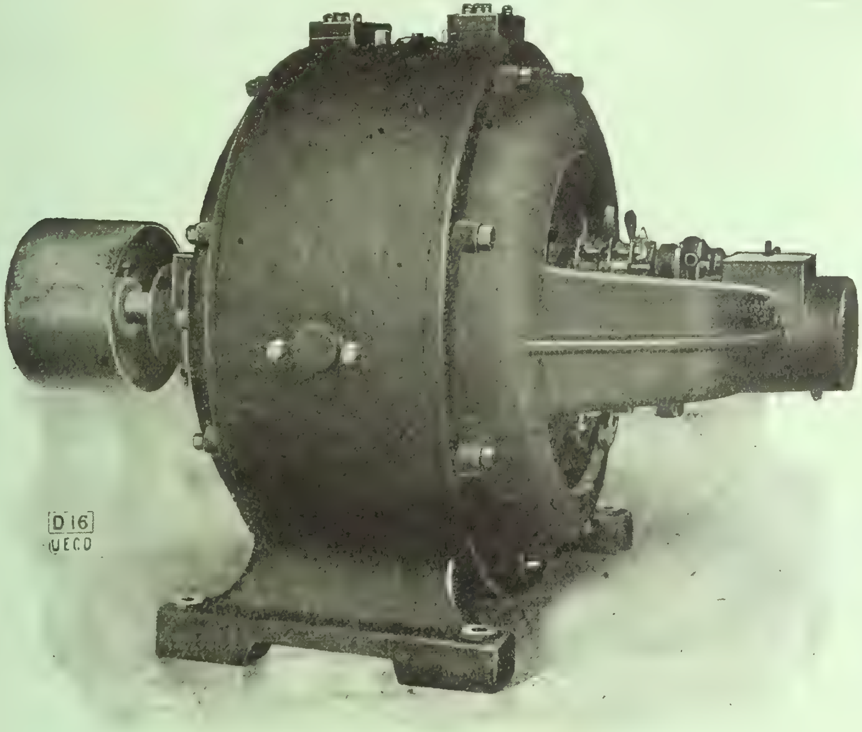

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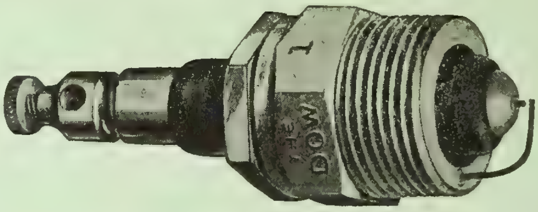

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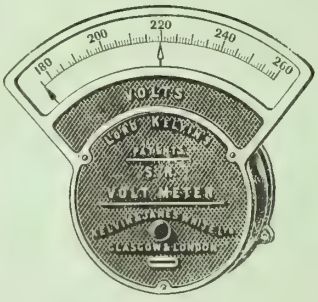

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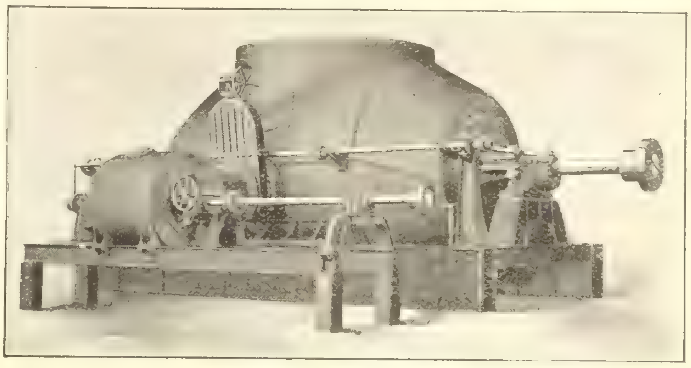

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PUBLICATIONS

A book entitled "Magnetism and its Elementary Element" has been published by Messrs. Lonmans, Green & Company, 39 Paternoster Row, London, Eng. The author is W. Hibbert F.I.C.A.M.I.E.E. The book is the first part of a larger volume dealing with magnetism and electricity and sells for two shillings.

The Westinghouse Companies' Publishing Department, Pittsburg, Pa., have issued a very attractive booklet in behalf of the joint Westinghouse interests for distribution at the Louisiana Purchase Exposition. The book describes and illustrates the works and products of the Westinghouse Companies both in American and Foreign Countries.

All persons interested in the generation of power will be much interested in Bulletin No. 834 issued by the Canadian General Electric Company. It refers to the Curtis steam engine, and by means of numerous illustrations shows its design and construction very clearly. The illustrations include the elevation and plan of the new turbine central station being erected by the Edison Electric Illuminating Company at Boston, Mass., which station when completed will contain twelve 5,000 k.w. Curtis steam turbines. Curves are also given showing the steam consumption at different loads, the effect of superheat on steam consumption and the effect of speed on steam consumption in a 500 k.w. Curtis turbine at Newport, R.I.

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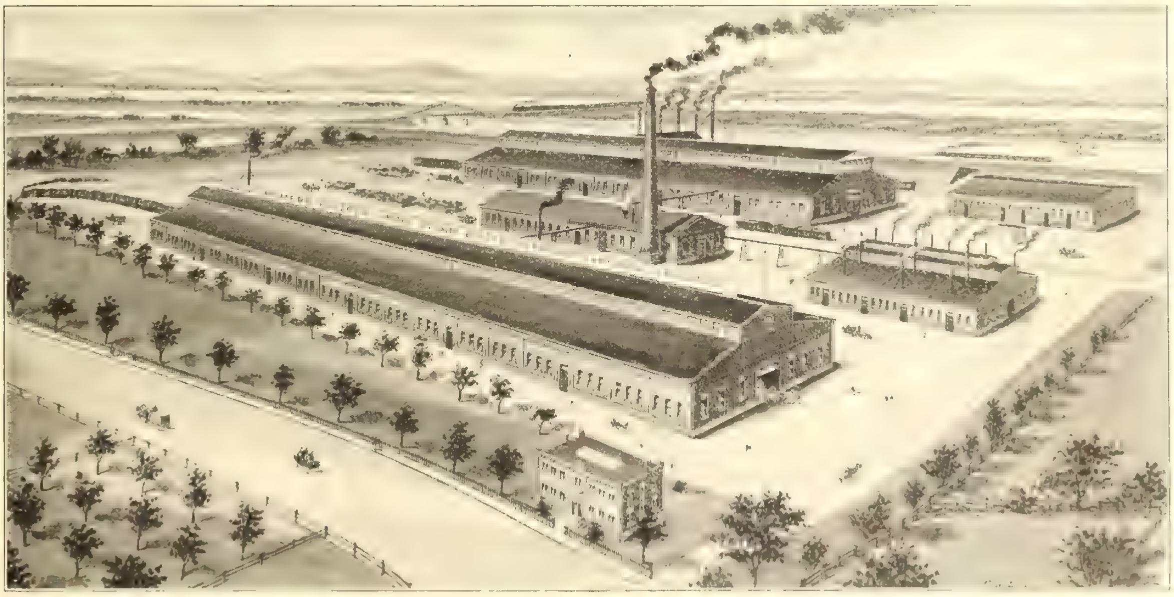

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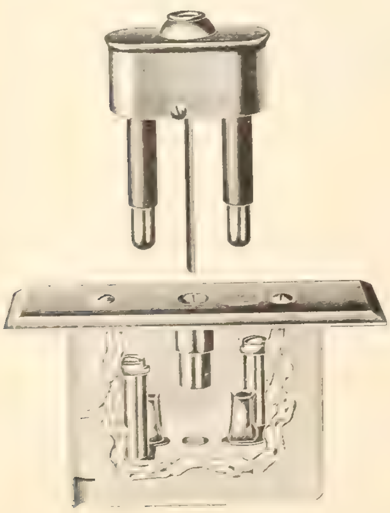

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Receptacle Closed

SPARKS.

The ratepayers of Wetaskiwin, N.W.T., have voted in favor of expending $25,000 for a municipal electric light plant.

The Canadian Pacific Telegraph Company's system in the west is to be improved and greatly extended, necessitating the use of a large amount of copper wire and other materials.

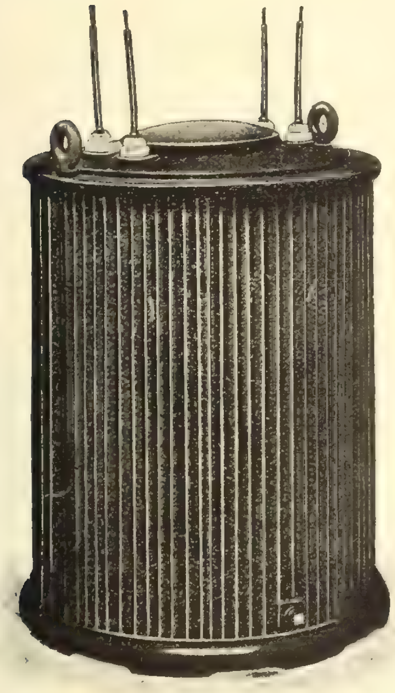
The work of building a telegraph line from Arrowhead to Nakusp, B. C., has been completed. The line is also being rebuilt from Slocan City down the lake a distance of eighteen miles.

The annual meeting of the Canadian Electric Light Company was held at Quebec last month, when the following directors were elected: Rodolphe Audette, H. M. Price, W. A. Marsh, G. Lemoine, Charles King, H. T. Machin, Joseph Paquet, William Doyle and R. Wilson Smith.

The Stave Lake Power Company, of Vancouver, B. C., have elected the following directors for the ensuing year: President, John Hendry, Vancouver; vice-president, S. G. Faulkner, Vancouver; acting-secretary and treasurer, R. A. Welsh; G. C. Hinton, Sir C. H. Tupper, J. H. Senklear, Vancouver; R. E. Walker, F. DeGray, New Westminster. The company are considering an offer to dispose of their plant.

Mr. C. P. Raikes, Canadian representative of Harper Bros. & Company, London, Eng., recently made an inspection of the proposed route of the Brantford and Lake Erie electric railway. Mr. Raikes, who is a civil engineer, reports that there are no unsurmountable engineering difficulties, and it is probable that the road from Brantford to Port Dover will be placed under contract at an early date.

A new type of electric locomotive, which will haul passenger trains at the rate of seventy-five miles an hour, is being built by the General Electric Company and The American Locomotive Company for the New York Central Railroad. The engine will develop about 2,500 horse power. The total weight of the locomotive will be eighty-five tons. Each of the driving wheels, of which there are eight, arranged in four pairs, will carry a weight of 17,000 pounds.



Power Transformers.

If you are figuring upon supplying power or light to consumers at a distance, you will be interested in these Transformers. We make them in sizes from 50 k. w. up to 300 k. w. and up to 30,000 volts. Should you wish more information about them we will be very glad to supply it.

Note.

The cheapest way to buy Pittsburgh Transformers is under yearly contract. A postal card will bring one of our proposal forms; it doesn't cost anything and may do you some good. Shall we send one?

Pittsburgh Transformer Company,
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Pittsburgh, Pa.
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Send for Price List. - Discount to Trade.

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TRADE NOTES

The Ottawa Car Company have recently built six cars for the Winnipeg Street Railway.

Mr. Louis Terven, E.E. (University of Wisconsin) has recently been appointed chief electrician of the Nernst Lamp Company, Pittsburg, Pa.

Messrs. Reid and Kilmer, Hamilton Ont., representing the General Electric Company, of Sweden, have obtained a contract to furnish a 420 k.w. generator for the town of Fenelon Falls, Ont.

The Packard Electric Company, St. Catharines, Ont., has secured a very large contract for electric meters from the Winnipeg Street Railway Company, who furnish commercial lighting in that city.

The Crocker-Wheeler Company, of Ampere, N.J., announce that by arrangement with the celebrated electrical engineers, Brown, Boveri & Cie, of Baden, Switzerland, they have secured their alternating current designs, patents and rights to manufacture in America. The former are now putting on the market alternating current generators, transformers and accessories of the best design and construction adapted to American practise, and have retained the Swiss firm as consulting engineers.

The Toronto Street Railway Company have recently placed an order with Sheldon & Sheldon of Galt, Ontario, for two 180" fans for forced draft to be used in connection with the Jones stokers, which they have installed. These together with the two other fans of the same size and make, which are already installed, will make the largest plant of this kind in Canada. The fans are of the three-quarter housing type direct connected to engines and have a capacity of approximately 90,000 cubic feet of air per minute each at two oz. pressure.

The Cranbrook Electric Light Company, who control the telephone system in the vicinity of Cranbrook, B.C., are extending their lines to Moyle and Wardner.

TRUMBULL ELEC. CO.

The Most Progressive
and Up-to-Date Line
in Existence.

Let us send you our New Bulletins,
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PERSONAL

The death is announced of Mr. Charles E. Barrett, of the accounting staff of the West Kootenay Power & Light Company, Rossland, B.C.

A pretty wedding took place in Toronto last month, when Miss Laura Sturrock was united in marriage to Mr. John S. Macdonald, Superintendent of Government Telegraphs for the North-West Territories. Mr. and Mrs. Macdonald will reside at Qu'Appelle, N.W.T.

Mr. W. J. Webb, chief engineer for the Lawlor Estate building, corner King and Yonge streets, Toronto, has tendered his resignation, and will leave this month for Winnipeg to become chief engineer for the new Union Bank building now nearing completion in that city. This is the largest and most complete office buildings in Winnipeg and cost upwards of $400,000. We wish Mr. Webb success in his new field.

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CANADIAN CONTRACT RECORD
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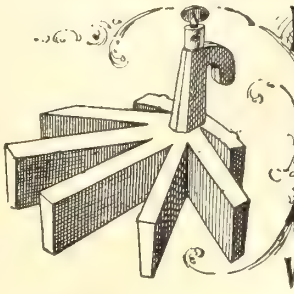

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SPARKS.

The Canadian Pacific Railway Company have given the Manitoba Construction Company the contract for building their proposed power house in Winnipeg.

The Toronto & Niagara Power Company have commenced work on their sub-station to be erected on Davenport road on the outskirts of Toronto. The building will be 225 x 80 feet, of concrete, stone and steel, and will cost about $100,000.

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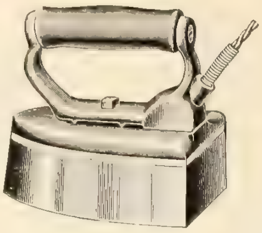

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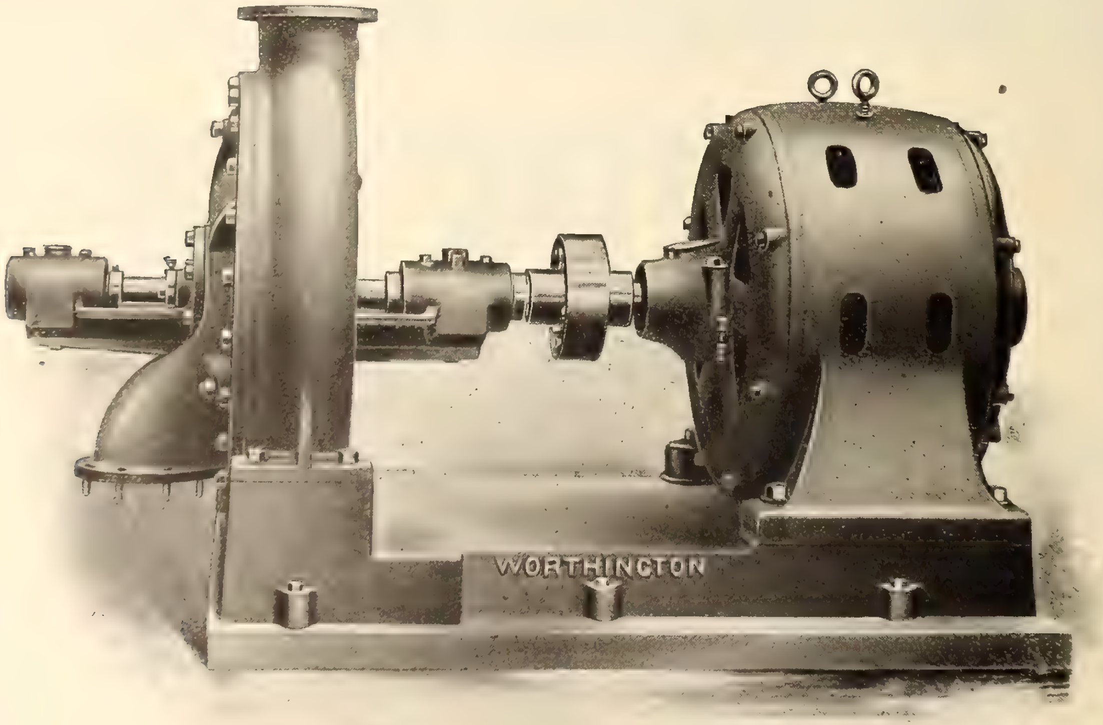

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WHITNEY INSTRUMENTS ENJOINED

Full Opinion of His Honor Judge Wheeler, concurred in by His Honor Judge Lacombe in the case of the

WESTON ELECTRICAL INSTRUMENT CO. Complainant

VS.

WHITNEY ELECTRICAL INSTRUMENT CO. Defendant

This suit is brought upon patent No. 392387 dated November 6, 1888, and granted to Edward Weston for an Electrical Measuring Apparatus, which was adjudged to be valid in Weston Electrical Instrument Co. vs. Jewell Electrical Instrument Co. et al in this Court in March, 1904. It has now been heard upon a motion for a preliminary injunction.

The principal question made now is as to infringement. **The parts of the defendant's instrument look quite differently from the corresponding parts of the instrument of the patent, but notwithstanding these differences in form they are there in the instrument and do the same things in substantially the same way.** This appears quite well from the description of the two instruments in parallel columns in the affidavit of Frank W. Roller, defendant's record on this motion, page 3. The great thing to be done appears to have been to get the movable coil in its diamagnetic frame into a permanent magnetic field, compactly, and to carry the current to be measured from side to side through the coil, and move the coil against steady resistance to measure the current, and record the measurement. Weston seems to have accomplished this by mounting the frame by pivots on non-conducting bridge-pieces, and carrying the current to be measured to and from the movable coil through springs connected with the frame furnishing steady resistance, and a pointer connected with the frame and moving over a scale to show the movement and the measurement of the current.

Any electrical mechanic could provide the permanent magnetic field, and the form of it would not be material except to permit the movement of the frame carrying the coil. The mounting of the frame on the bridge-pieces by pivots with its arrangement and connections was the important part of Weston's patented invention.

The defendant's instruments have the permanent magnetic field provided by a magnet and core of different and perhaps better shapes in some respects, but permitting movement of the frame in an arc of a circle to carry a pointer moving over a scale to indicate the measurement of the current. **If these changes of forms are even patentable improvements the defendants have taken and used the invention of the patent in making and using those improvements.**

The difference in the form of the parts carrying the frame on pivots supported by the bridge pieces is of the same sort. It does not vary the mechanical operation of the parts. **These differences do not, any or all of them, amount to doing the same thing in different ways, but leave the operative parts doing the same thing in the same way.**

According to these views the motion should be granted.

HOYT H. WHEELER,
Judge.

For Plaintiff:
WILLIAM HOUSTON KENYON.

For Defendants:
CLIFTON V. EDWARDS.

Upon re-examination of the record, I concur in the opinion above expressed by Judge Wheeler.

July 18, 1904. E. HENRY LACOMBE,
U. S. C. J.

(Endorsed) Circuit Court of the United States, for the Southern District of New York—Weston Electrical Instrument Company vs. Whitney Electrical Instrument Company et al.—Opinion, WHEELER, J.—United States Circuit Court, Southern District of New York. Filed July 20, 1904. John A. Shields, Clerk.

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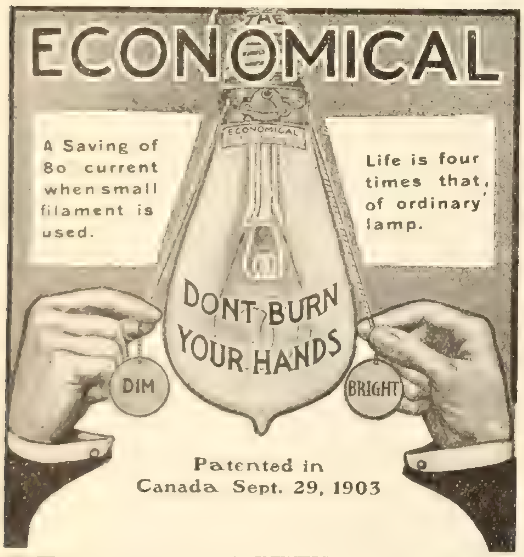
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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIV. AUGUST, 1904 No. 8.

THE CAPE BRETON ELECTRIC COMPANY.

The property operated by the Cape Breton Electric Company is owned by Messrs. Stone & Webster, who also own a half interest in the Sydney and Glace Bay Railway Company. The Cape Breton Electric Company own and operate the street railway lines in Sydney and North Sydney, Nova Scotia, and the electric lighting systems in both, with a separate power house in each town.

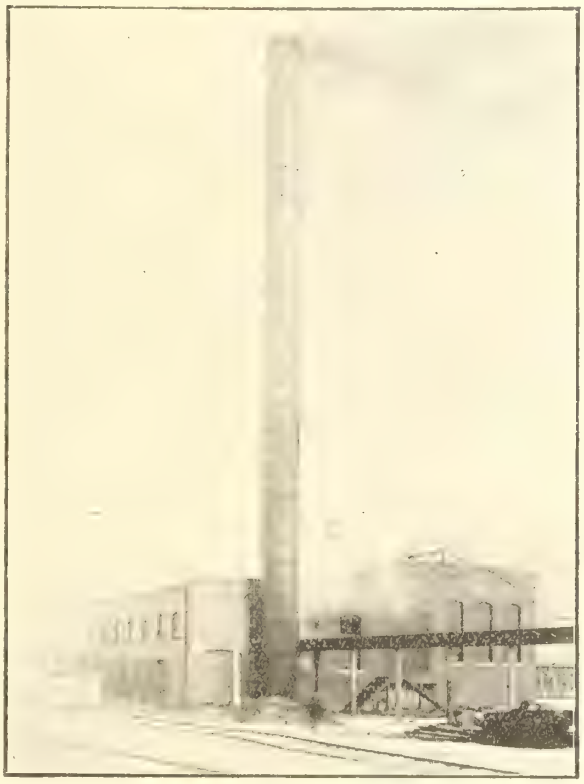

FIG. 1.—POWER HOUSE AT SYDNEY.

The power house in Sydney, shown in Fig. 1 is equipped with two 500 horse power, cross-compound condensing engines, directly connected to two 300 k.w. generators, one for the railway and one for the lighting. In this power house there is also one high speed engine belted directly to one 300 k. w. alternator and one 300 k. w. railway generator. The complete equipment is of Canadian manufacture. The power house is modern in every respect, and is considered to be one of the most economical in Canada in point of operation. It furnishes the current for all the lighting in Sydney, as well as power for the street railway in Sydney and the interurban railway from Sydney to Glace Bay and through the coal colleries.

The power house in North Sydney is the station occupied by the old lighting company. It was taken over by the Cape Breton Electric Company and is being used pending the building of a new and modern structure along the lines of the Sydney power house.

The street railway lines in Sydney comprise about 7 miles of single track with necessary sidings. The rolling stock consists of closed cars exclusively, 18 feet in length, single truck, manufactured by the Ottawa Car Company and equipped with the Canadian General Electric Company's "67" type of motors. The North Sydney rolling stock equipment is practically the same. The Sydney and Glace Bay Railway is equipped with large interurban cars 44 feet over all, cross seats, with an aisle through the centre. They were built by the Ottawa Car Company, are equipped with four C.G.E. "67" high speed motors, and are capable of operating at a speed of 50 miles per hour. The length of the road is about 22 miles, running from Sydney to Glace Bay and through the coal colleries of the Dominion Coal Company.

Fig. 2 shows a viaduct over the Sydney and Louisburg railway at one of the coal colleries, known as "Dominion No. 1", over which the Sydney and Glace Bay railway cars operate. Fig. 3 is a view of the Sydney and Glace Bay Railway cars at Reserve Junction. At this point, which is eight miles from the terminus of the road in Sydney, the cars separate for their different routes in the coal colleries and Glace Bay. Fig. 4 shows the car barns of the Cape Breton Electric Company, also the tracks where they cross the main line of the Intercolonial Railway. This crossing is protected by a derailing device in the electric road, which is operated by the train men at the point where the tracks cross each other.

The manager of the Cape Breton Electric Company is Mr. E. S. Dimmock, who commenced his railroad career when only thirteen years of age as an apprentice in the shops of the Ohio and Mississippi Railway, now the Baltimore and Ohio. He followed railroading in various capacities, such as master mechanic, superintendent of motive power and machinery. He first entered the street railway field in the year 1884, when he took charge of the elevated railroad running from Kansas City, Missouri, through the city of Kansas to Wyandotte. In 1891 he assumed charge of the Denver Consolidated Electric Company, of Denver, Col., remaining in that position until 1893, when he went to South Omaha, Nebraska, as superintendent of the Electric Light Company and master mechanic of the Union Stock Yards Company, which controlled same.

Mr. Dimmock remained in South Omaha for four years, when he was asked to assume the managership of the Bay City Consolodated Railway Company, of Bay City, Mich., which road had just gone into the hands of receivers. He entered upon this position in August, 1889, and during the next four years rebuilt and revamped the road throughout, some thirty miles in all, purchasing new rolling stock, building new power houses and car barns, and acquiring the summer resort known as Winona Beach Park, on the Saginaw Bay. Upon the road being sold by the United States Court to Messrs. Clarke & Company, bankers and brokers of Pennsylvania, who are owners of some large railway properties in the United States, Mr. Dimmoch resigned the general managership to assume his present position as managing director of the Cape Breton Electric Company for Messrs. Stone & Webster.

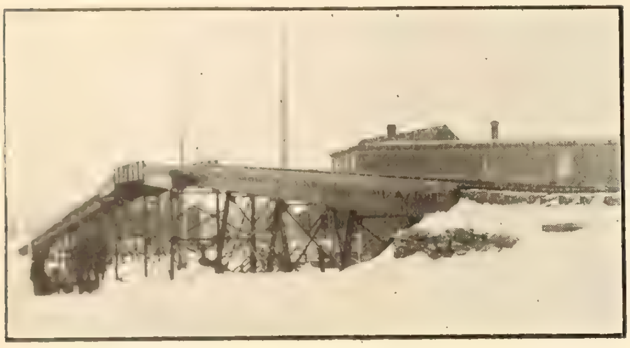

Fig. 2.—Viaduct Over the Railway at Coal Collirry.

NATIONAL ELECTRIC LIGHT MEMBERSHIP

At the last convention of the National Electric Light Asssociation an amendment was adopted dividing the membership into six classes, as follows :

Class A, member companies : Private corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use. Entrance fee, $25 ; annual dues for companies in towns of less than 20,000 population, $10 ; 20,000 to 300,000, $25 ; over 300,000, $50.

Class B, members : Officers or employees of member companies, elected and continued from year to year with the written consent of the member company with whom connected. Entrance fee, $5 ; annual dues, $5.

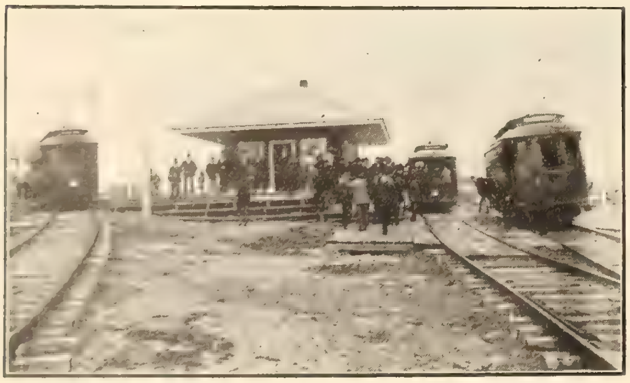

Fig. 3.—Sydenham and Glace Bay Cars at Reserve

Class C, instructors and teachers of engineering and related sciences ; No entrance fee ; annual dues, $4.

Class D, associate member companies : Electricians, electrical or mechanical engineers. manufacturers, corporations or individuals who are directly or indirectly interested in advancing the interests of electricity. Entrance fee, $25 ; annual dues, $20.

Class E, officers and employees of Class D, elected and continued by written consent of the Class D member employer. Entrance fee, $5 ; dues, $5.

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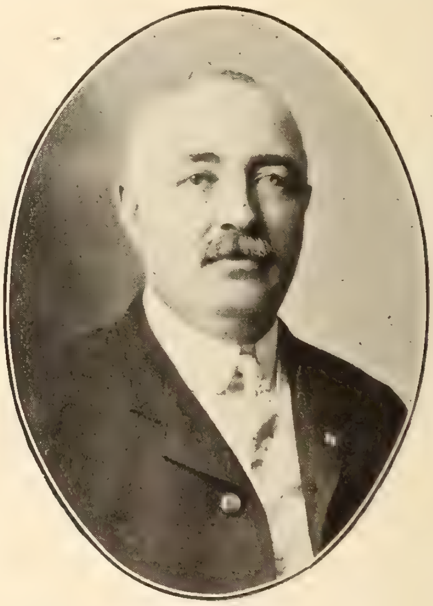
STEAM AND ELECTRIC PLANT AT THE ST. LOUIS EXHIBITION.

The total space devoted to the service electric plant in Machinery Hall, St. Louis, with the exciter units, condensers, cooling towers, and the 35-panel switchboard, is 26,260 square feet. The entire steam and electric station was designed and equipped by Westinghouse, Church, Kerr & Co., and all the motive power apparatus in connection with the generators, and in the steam generating plant in the nearby boiler house, was furnished by the Westinghouse Machine Co. The electric plant, although within the Westinghouse walls at the west end of the machinery hall, has not been laid out on elaborate lines to combine the diverse characteristics of exhibition and service, and is an exhibit plant only in so far as it is representative of thoroughly modern practice at minimun cost. The various organizations associated with the Westinghouse name, which have united in representation at St. Louis under the title of "Westinghouse Companies at Louisiana Purchase Exposition," have additional adjoining exhibit space in Machinery Hall of 26,260 square feet, space in the Palace of Electricity of 10,100 square feet, where Baldwin-Westinghouse electric trucks and locomotives also are shown, and space in the Palace of Transportation of 3,000 square feet, a total of 65,620 square feet, or nearly ten times the space occupied by the same interests at the Pan-American Exposition at Buffalo in 1901. The organizations associated in these joint exhibits, which represent an army of 30,000 employees, and occupy a total workshop floor space of over 140 acres.

Fig. 4.—Car Barns.



C. S. Dimmock,
Manager of the Cape Breton Electric Company.

CANADIAN ELECTRICAL NEWS TECHNICAL SCHOOL

This journal will be glad to devote a part of each issue to the service of those of its readers who wish to join us in a kind of Electrical Technical School.

By question and answer and discussion we will attempt to review or develop mutually our knowledge of principles or to draw upon one another's experiences in the general field of electrical industry.

We shall be glad to receive questions or suggestions for such from our readers. You are in the best position to offer such suggestions for the problems that you have to work out in your part of the field today are the problems that some others of us may have to consider tomorrow or the next day.

QUESTIONS.

T 1.—Define and illustrate clearly the use of the terms : Work, power, horse power, watts. Contrast work and power. State the relation between a horse power and a watt.

T 2.—What are i.h.p., b.h.p., b.h.p. hour?

Criticise the statement met very frequently that "power is worth" so much "per 1,000 watts."

T 3.—Upon what parts or functions of a generator does the production of E.M.F. depend? To what is it proportional?

P 1. What is the proportionate saving in coal in one of the two following arrangements over the other for pumping water for town supply :—(1) Employing a steam pump which requires 55lbs. steam per i.h.p. hour ; or,—(2) driving a pump by an electric motor with 88% efficiency which receives its current from a generator having 92% efficiency. The generator is driven by an engine which uses 27 lbs. steam per i.h.p. hour and has an efficiency b.h.p. : i.h.p. of 98%.

State the assumptions implied in the above.

P 2.—Give the more common causes of hot bearings.

P 3.—What are usually the conditions to be considered in planning an electrical plant for a town supply.

To add to the interest we will keep an account of all answers sent in and place those who answer a certain proportion of the total upon a competitive basis. The names of those who obtain above a certain percentage will be given in a list and prizes will be awarded to several who stand at the head.

Further details will follow in next issue.

Kindly send in your answers to the above questions as early as possible, say by the first of September, so as to allow time for considering them before the next issue, though they will count in the competition if they reach us before the next issue has been mailed.

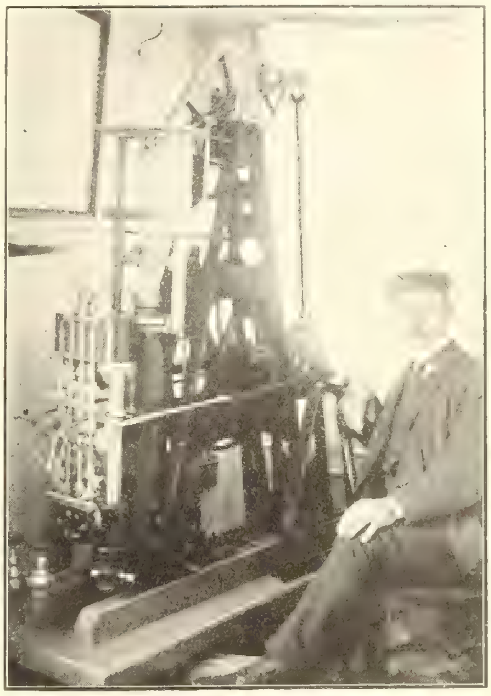
The Cranbrook (B.C.) Electric Light Co. are extending telephone lines from that city into the surrounding district.

Mr. J. M. Campbell has been engaged by the City Council of Kingston, Ont., to superintend the remodelling of the electric and gas plant recently acquired by that city. The work will likely extend over a year and Mr. Campbell is to receive a fixed salary.

The Toronto & Niagara Power Company have awarded a contract to the Dominion Wire Manufacturing Co., of Montreal, for 1,500.000 pounds of copper wire for their transmission line from Niagara Falls to Toronto. There will be six cables strung on steel towers 40 feet high and situated 400 feet apart.

INVENTOR OF A MARINE ENGINE

Mr. William Leclair, the dean of French-Canadian mechanical engineers, has completed a model of a marine steam engine, of which an illustration is shown. The work has taken many years to perfect, but at last he is satisfied that his pet scheme is one that will meet with the approval of the engineers and the public.



Mr. Wm. Leclair.

In his modest home on St. Ambroise street, St. Henri, Mr. Leclair, who is now sixty-two years of age, has his engine, which besides being mechanically perfect, is said to be a real work of art. It was built at Sorel some years ago, after the model of the engines on the "Carolian," but with improvements which the inventor believes will render it much more valuable. For twenty-seven years he has been nursing his favorite scheme.

THE OTTAWA ELECTRIC COMPANY

The tenth annual report of the Ottawa Electric Company shows that the gross revenue from all sources for the year ending April 30th, 1904, aggregated $211,683.28. The expenses show an increase of $18,678.53, accounted for by work of a special character in the nature of permanent improvements, including the reconstruction of the main switchboard and the rebuilding of the company's lines destroyed by the fire of May 10th and June 4th, 1903. The net profit for the year was $47,734.36. The installations show additions for the year of 12,524 incandescent lights, 99 arc lights, 23 power motors, with 616 additional customers. A statistical statement of the business of the company for the past ten years is as follows :

Date	Lights Inc.	Lights Arc.	Heaters	Motors	Customers
July 27/94 ..	42,152	440	11	81	[illegible]
April 30/95 ..	48,797	468	15	81	3,007
" 30/96 ..	53,331	407	19	81	3,213
" 30/97 ..	57,240	550	30	87	[illegible]
" 30/98 ..	63,173	500	32	96	[illegible]
" 30/99 ..	77,755	621	23	103	[illegible]
" 30/00 ..	87,114	644	23	103	4,357
" 30/01 ..	93,207	650	17	133	5,208
" 30/02 ..	104,407	752	24	157	5,820
" 30/03 ..	114,133	887	30	163	[illegible]
" 30/04 ..	126,657	986	30	186	6,757

INVENTION and DEVELOPMENT
IN THE ELECTRICAL FIELD

Scott's Alternating-Current Distribution System.—Mr. Charles F. Scott, of Pittsburg, Pa., past president of the American Institute of Electrical Engineers, and who is well-known to many Canadians, has invented a system of alternating-current distribution which is designed to supply electric cars on two parallel tracks from a single transmission line. The illustrations show the connection in the system. In Fig. 1 a three-phase generator is shown as indicative of the power-house source of supply for the three-phase transmission line (2), it being understood that the source may be either a single generator or a number of generators connected in parallel to the transmission line and that it may also include step-up transformers in case a higher transmission electromotive force is desired than may be conveniently supplied directly by the generators. The two trolley conductors (3) and (4) are shown as overhead conductors. The respective track rails (7) and (8) of the two parallel lines of road are shown as constituting the return conductors of the work circuit. In order to supply each of the working circuits with a single-phase current for operating its motors, two transformers (9) and (10) are employed, the primary windings (11) and (12) of which are connected to each other and to the three-phase circuit. The secondary windings (13) and (14) of these two transformers have their respective outer terminals connected to the trolley conductors by means of conductors (15) and (16), and their inner terminals are connected together and to both of the return conductors by means of a conductor (17). It follows from this arrangement of apparatus that a saving of conductors for the transmission circuit is effected by employing a three-phase system and that a further saving is effected by using the rails of the two roads as a common return for both circuits, thus reducing the current in each rail-return below that in each of the trolley conductors. In Fig. 2 the source of energy is represented by a single-phase generator (1^a), and the transmission circuit (2^a) is therefore a single-phase circuit. Energy at a lower potential may obviously be derived from the transmission circuit for the translating devices by means of separate step-down transformers; but in the illustration energy is supplied to the two work circuits by means of a single transformer (18), the outer terminals of the secondary (19) of which are respectively connected to the power conductors (3) and (4) by conductors (20) and (21). An intermediate point in the secondary winding is connected to both of the return conductors by means of a conductor (22). This arrangement may be made such as to provide for separate voltages for the two work circuits, if desired, by connecting the conductor (22) to some other than the middle point of the winding. In Fig. 3 the power-house source of energy is represented by a two-phase generator (1^b). As shown, the two return conductors (here indicated as the track rails) constitute the return conductors for the generator (1^b) as well as of the transformers which directly supply the work circuit. The other portion (2^b) of the transmission circuit is connected to the conductors by transformer windings (23) and (24). Intermediate points in the windings are connected to the respective conductors by conductors (26) and (27).

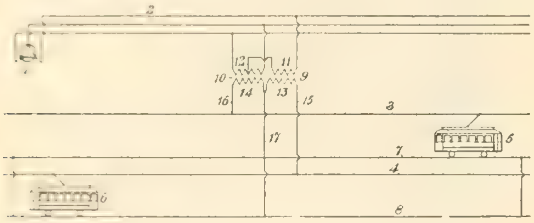


Fig. 1.

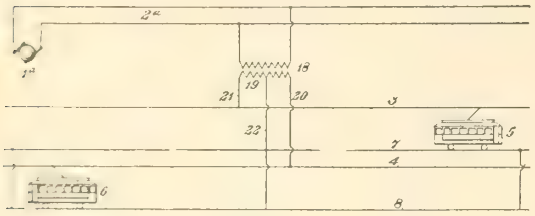


Fig. 2.

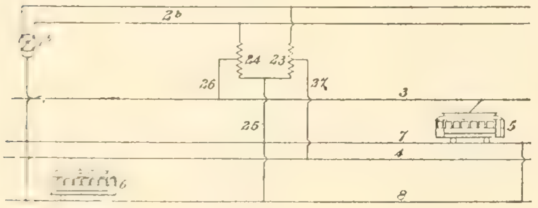


Fig. 3.

Scott's Alternating Current Distribution System.

New Inverse Time Limit Relay.—The Westinghouse Electric & Manufacturing Company have placed on the market a new inverse time limit relay. It is made in types for both single and polyphase circuits, the single phase relay containing one electro-magnet with its regulating mechanism and the polyphase type consisting essentially of two single phase mechanisms in a case, and properly connected. The electro-magnet consists of two coils connected in series with a series transformer, and having a U shaped laminated iron core from which the moving contact is suspended. When an overload occurs, the core is drawn into the coils, raising the moving contact until connection is made with the stationary contact and the tripping circuit is closed. The variable time element is supplied by an air check which is connected with the magnet core by a vertical rod. As the core and moving contact rise, the air in the checking chamber is compressed and acts in the same manner as a dash pot in retarding the closure of the circuit. An intake valve allows the checking chamber to fill quickly when the overload is removed, and the relay is thus automatically reset. The outlet valve furnishes the inverse time limit feature, as the ball which closes the valve is held lightly under the compression of a coiled spring, the amount of the pressure upon the valve from within regulating the size of the opening. When a slight overload occurs, the pressure upon the check is light and the air escapes slowly through a small opening. In the event of a short circuit, the magnet core would be drawn rapidly upward, the air being expelled quickly from the valve which the pressure would force wide open, and the tripping circuit would be closed. The effect upon the time limit varies with the amount of overload, the length of time being in inverse proportion to the excess of current. Should the overload cease before the contacts touch, the magnet core drops to its original position and the relay is reset. The simplicity of this arrangement ensures its perfect action under all conditions and permits a sturdiness of construction not always found in conjunction with so sensitive and delicate an operation.

Steel Towers for Transmission Lines.—A steel tower transmission line, 100 miles long, serves for the support of conductors from the plant of the Guanajuato Power & Electric Company, Mexico. The towers weigh 1,500 pounds apiece and are of the four-post wind-mill type standing 40 feet above the ground on a base 8 feet square. About the top is a square wooden platform for the convenience of workmen. Each of the four legs carries a 3-inch piece of angle-iron which rests on the bottom of the post holes. The cross pieces answer both as supports and anchors. Three conductors are carried in the usual triangular formation. The top insulator pin is screwed on the end of a 3-inch iron pipe extending 6 feet above the top of the tower, and the two others are fastened to two 4-inch channels forming a cross-arm at the base of this pipe. The towers cost, in lots of 500, $53 apiece; including the insulators, with twelve towers per mile, the total cost is $690 per mile. A sag of 7½ feet is allowed between towers. According to Mr. L. A. Sanford, a gang of six Mexicans assembled three towers daily. As an average, 4 miles were strung, the slack pulled up, and the cables tied in at the insulators in a day. The main cables were not transposed, but the telephone wires, placed about 7 feet below the cross-arms, were transposed every two towers. A sag of 7½ feet was allowed between towers. Two to five mules were used to pull each cable. In rough country the slack was pulled up every mile and temporarily held with steel guys. In level country a two-mile pull gave good results.

The Blondel Arc Lamp.—Andre Blondel, of Paris, a distinguished French engineer, has invented an electric lamp which contains many important improvements. It is of the open arc type, gives a brilliant distribution and a high efficiency, and it is said the quality of the light can be varied considerably and made much whiter than the ordinary carbon arc.

The peculiarities of this lamp are three: first, one of the carbons is a composite carbon—that is, it contains a proportion of certain salts which have the property of increasing the luminosity of the arc; second, in the direct-current Blondel lamps, the positive carbon is placed at the bottom; third, around the upper carbon, and just above the arc, is placed a reflector. Each of these features has a distinctive value, and adds to the effectiveness of the lamp. The arrangement is shown in the accompanying illustration. Tests made by a committee of the National Electric Light Association show that a 6.6-ampere 110-volt direct-current enclosed lamp, without the outer globe, gave a maximum luminosity of a little over 450 candles, with an expenditure of 726 watts. A five-ampere fifty-volt direct-current Blondel lamp, without the globe, gave over 2,700 candles, with an expenditure of 250 watts. It is interesting also to compare the three-ampere fifty-volt Blondel lamp—taking 150 watts—with the ordinary enclosed arc lamps. The report shows that, for the three-ampere Blondel lamp, operating at 50.3 volts, the mean hemispherical candle-power was 790 candles. The specific consumption was 0.191 watt per candle. For the five-ampere lamp, without the globe, the mean hemispherical candle-power was 1,883, and the specific consumption 0.133 watt per candle.

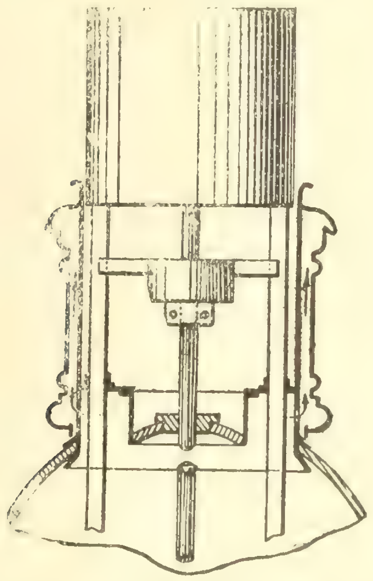


Diagram of Parts, Blondel Arc Lamp.

A One Hundred and Ten-Mile Transmission.—The Washington Water Power Company, Spokane, have completed their 110-mile transmission line, which is one of the longest yet put into commercial operation. In the generating station two 2,250 k.w., 4,000 volt, revolving field generators, each connected to a Victor turbine, operating under a head of seventy feet, have been installed. The exciter is direct connected to a separate water wheel without governor. Three water cooled transformers step the voltage up from 4,000 to either 45,000 or 60,000 volts, depending upon connection, for the long distance transmission. The line is approximately 110 miles long to the furthest power user. A portion of it runs through marshy or boggy country, where considerable trouble was experienced last winter from ice forming around the pole butt and finally lifting the pole out of the hole. This difficulty was overcome by putting horizontal cross pieces on the butts underground. The line consists of three No. 2 solid copper wires, with 60,000-volt Locke insulators and iron pins. The pins are made of about three-inch wrought iron with cast iron shanks, for insertion in cross-arm and lead threads. There are six sub-stations, each equipped with three-phase, step-down, water-cooled transformers varying in size from 100 kilowatts to 750 kilowatts, with primary taps for 60,000 or 40,000 volts according to the line pressure. The power is used almost exclusively for mining purposes. At the Standard and Hecla mines four General Electric, 300 horse power induction motors are used to drive compressors, hoists, etc. One of these motors is geared direct to a hoist. The synchronous motors are started direct from the line through low voltage taps on the transformer.

Superheated Steam for Engines.—The Electrician, of London, Eng., gives some technical information with regard to the central-valve engines working with superheated steam. The manufacturers of the engines, Willans & Robinson, of Rugby, claim that splendid results have been obtained. It appears that a number of Willans engines have been running for some years past with superheated steam, the results, however, are only now being made public—i.e., after prolonged tests have satisfied the makers that high temperatures have no detrimental effect upon the working parts of their engines. Many machines, it is said, have been running in stations using steam at a temperature of 600°F. with perfectly good results, and careful tests have been made up to temperatures of 700°F. in order to ascertain their behaviour under any exceptional fluctuations of temperature. These tests, we understand, have been equally satisfactory. I is interesting to note that the firm have observed that the quantity of lubricating oil used is usually less than with saturated steam. The price of the special oil used appears to be moderate. It is claimed that the symmetrical form of the Willans cylinders and the absence of irregular-shaped valve chests, of heavy, flanges, &c., renders distortion under high temperatures impossible; also that the absence of white metal or soft metal packing in the glands removes one of the most frequent sources of trouble with superheat. The glands are packed with phosphor-bronze or cast-iron rings. The gland rings, piston rings and valve rings are all spring rings, not solid rings; consequently, while always remaining tight, they always have sufficient clearance at all temperatures, and work equally well however much the temperature may vary, an important point in view of the difficulty of maintaining a constant superheat. Engines with solid valves must have them fitted to give a working clearance at the highest temperature required, and at lower temperatures there is leakage. The rings and springs being of cast iron, are not in any way affected by high temperature as is the case with steel springs. They do not, therefore, lose their efficiency under superheat, and the fact that they are steam packed is an additional guarantee of tightness under all conditions.

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Correspondence is invited upon all topics coming legitimately within the scope o this journal.

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Electric Railway Motors.

In our issue of a couple of months ago we referred to the prominence now being given by engineers to the single phase alternating current motor as a promising factor in the electric railway work of the near future. It is interesting in view of approaching developments to glance over the situation and see what effect the introduction and, at present, almost universal use of alternating currents by large central stations, has had on electric traction problems ; and in doing so we find entirely different conditions to obtain in America as compared to Europe.

This continent has undoubtedly been the pioneer in electric railway work, at least electric street railway work. The series wound direct current motor was found to have characteristics eminently suited for the conditions to be met, chief among which being the capacity for exerting a very large starting torque. No other type of known motor approached it in qualities of this kind and accordingly all systems were laid out with a view to its use, and designing engineers bent all their endeavors to perfecting machines of this type.

Then came the discovery of the induction motor and the extended use of polyphase alternating currents. As transmission plants were installed it was only natural to exploit the induction motor in the railway field, and it soon appeared that it was deficient, as compared with the series wound direct current motor, with respect to two most important features, namely, starting torque and adaptability for variable speeds, as it was essentially a constant speed machine. Many methods were devised to obtain various speeds, with the apparent results that the maximum current taken by a car was practically the average current. This meant an extremely large and expensive equipment in motors and a correspondingly large power plant to take care of it. In addition to this arose the complication of two or three overhead trolley wires, and as electric railways were largely confined to cities and towns this was a serious obstacle. The result was that progress was still along the lines of direct current traction, polyphase currents being used to transmit the power to substations along the line of railway where rotary converters were used to transform to direct current applied in the usual way. As the city railways extended to suburban lines and interurban roads were exploited, the distances involved became so great that numerous substations, with their rotaries and the expense necessary for the attendants, had to be built and equipped, or exceptionally heavy outlays in copper had to be borne.

Still clinging to his old friend the series motor, the Engineer turned to account one of its properties already well known but hitherto neglected by reason of limitations of design. This property was that of running on alternating current with practically the same characteristics as on direct current. With the low frequencies introduced in modern A. C. work, approaching those used in D.C. work, the difficulties in the way of dangerous sparking and heating were easier to meet, and such a machine was made a possible success ; so that today we have the American engineer looking forward to the evolution of the alternating railway motor in one of two types, the repulsion motor and the straight series motor. In each ease it may be assumed it is expected to use 25 cycles and a trolley voltage of about 3,000 volts.

Turning to the situation in Europe we find that their investigation has proceeded to a marked degree almost entirely along the lines of using polyphase currents. Efforts have been made to introduce systems adaptable for long distance work. Early experiments were made with induction motors and engineers became convinced that for trunk lines and long runs, constant speed motors were most suitable. The problem there appears to have been approached from a different standpoint from what it was on this continent. They have tried to solve the large problem at once, while here we have started with the slow speed many stop city systems and have extended and developed, naturally keeping along pretty well defined lines, and hoping gradually to evolve a successful system for general high speed and heavy work.

It remains to be seen whether the conservatism that has kept our European friends from catering to needs of the moment until such times as they could be assured of a successful solution of the whole problem of electric traction, will be justified or not. We will be able to judge somewhat of the success of their efforts in the application of polyphase currents to comparatively slow speed roads in the near future. We believe that the Ganz system, using 3 phase current, with a pressure of about 3,000 volts on the trolley is about to be installed by a Scotch firm, on the lines of the South Western Traction Company. Undoubtedly its operation will be watched with great interest by all Canadian Engineers, and it may be that we shall find that in our confidence of the soundness of our progress, we have blinded ourselves to opportunities which have been seized by our conservative but thorough going friends across the sea. And it is just possible too that we may find we are on the right track, while in any event we should be able to profit to no small degree by the experiments performed and experience gained in carrying out such propositions as the one referred to

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ENQUIRY.

A subscriber in Northern Ontario asks whether it is best to use round or flat iron on round flume holding 35 feet of water, break joint every two feet?

ANSWER—We take it that you wish to know whether flat or round iron is best to use as a band to strengthen the flume. If this is your meaning, we think that either "T" iron or angle iron would serve the purpose better than either flat or round iron.

The Canadian Northern Telegraph Co. has been granted a Dominion charter.

The name of Vernon & Nelson Telephone Company has been changed to the British Columbia Telephone Company, Limited.

The Ontario Power Commission, appointed to enquire into the power question on behalf of a number of municipalities, have acquired a vast amount of preliminary information and will proceed as soon as the necessary funds are provided. Seven cities, the number required to form the first group under the agreement with the interested municipalities, have agreed to pay their proportion of the cost, which was fixep at $15,000. Of this amount Toronto will pay $6,000, and Brantford, Stratford, London, Woodstock, Ingersoll and Guelph an equal proportion of the balance.

THE DOMINION EXHIBITION, WINNIPEG.

Office of The CANADIAN ELECTRICAL NEWS
310 McInyre Block Winnipeg August 6, 1904.

For Winnipeg to be full of people and accomodation scarce, is no uncommon occurrence, but for the past three weeks, on account of the Dominion Exhibition, previous experiences have been far and away eclipsed, it having been a matter of great difficulty to obtain a room in a hotel, boarding or private house. Charges have therefore been entirely in the hands of the residents, and it has been no unsual experience for visitors to give $2.00 or $3.00 per night for sleeping-room only. The number of visitors to the Exhibition has been very large and fully up to anticipation. The excursions have brought in trains continually, packed to overflowing, the class of visitors being in the main such as to warrant the assumption that genuine business was intended, and this has been fully confimed by the satisfaction expressed by many of the Exhibitors.

The Exhibition grounds are situated just outside the City limits and are easily reached by the Street Car service, the Management of which have really tackled the proposition in an excellent way, notwithstanding many difficulties which at one time threatened to prove a great hindrance.

Having reached the grounds, the visitor must not be surprised to find a plain, uninteresting entrance, with no pretence at any kind of show or effect, the fencing and entrance platform being quite of a tempory and indifferent character. Passing in, one is met with a fine double avenue of trees and open green, which are somewhat marred by the allowance of a number of tents arranged without much regard to symetry or order and equally disregardful of the uses to which they are put, newspaper men, cheap side-shows and catering booths being all together, with the Hospital tent and Telephone Booth to complete the mixture.

The first building to be noticed, and the only one with any attempt at appearance, is the old main building, which stands immediately at the side of the entrance avenue. Previously this building has contained the chief exhibits, but the year it has been give over to the Bazaar and fancy exhibitors, and has been receiving a good deal of attention, a continual stream of visitors passing through during the principal hours of the show, and this mainly, perhaps, on account of the many very fine exhibits of Art and Industrial work done by ladies and students.

Close by, and on theopposite side, are the Grand Stand and arena, where the daily competitions and shows have met with astonishing success, if the daily attendance is any indication in this regard.

At this point the entrance avenue, which extends for some distance, ends, and the visitor has immediately before him a large open space now used as the camping-ground for the Military who are in attendance, with the facade of the new collonnade standing out boldy in the back-ground,completely hiding the several buildings in which the Exhibition is held, and from which the Exhibition is held, and from which they have entrance, each by double doorways.

On the left, and continuing from, the old main building referred to, is to be found the section set off for amusement purposes, which is filled with a great number and variety of attractions, and is almost a town under canvas. It is at this point that the show proper really begins, by an out-door display of farmers' machinery, covering an area of several acres close to the C. P. R. track ; Many of these exhibits can be seen in operation, one firm being very active in demonstrating the erection and repair of their farm fences. Conspicuous at this part of the grounds is an attractive exhibit of four cottages, in various styles and coloured in several colours. This exhibit to show a new style of house especially adapted for surveyers' and Settlers' use. They are factory made and are despatched ready to be put together for habitation, minus all the detail labour of building. These houses are exhibited by The British Columbian Mills Timber & Trading Co., B. C., and are covered in the most important details by patent.

Passing from the Grounds to the Buildings themselves, the visitor finds that the former Dairy building and Poultry House remains just as on previous Exhibitions. In the Implemeut Sheds adjoining the Grounds there is to be seen a very fine collection of the smaller tools, implements and machines, and wherever possible demonstrations are in progress to explain the particular merits. There are also exhibited in this building two machines for making cement blocks, which attract a good deal of attention, the question of "building" being an especially important one to the farmer.

Dominion Exhibition, Winnipeg.—Exhibit of the Canadian General Electric Company.

The Visitor's attention is next turned to the three large new buildings which have been erected especially in view of the Dominion Exhibition, the first being that known as the Eastern Industrial, and which most certainly contains a number of very fine exhibits, in the main of a domestic nature, the various displays of furniture being particular attractive and shewing much artistic effect and finish. The "T. Eaton" display of their own manufactures has been generally admired and secured the Gold Metal awarded by the Directors for excellence of display.

The second building is known as the Eastern Machinery, and is especially devoted to those and kindred lines, the excellent light of this building adding not a little to advantage in display. Furnaces are shown by all the prominent makers, the principals of construction and operation being fully explained for the benefit of visitors. Decorators, too, could learn much in their art from the exhibits here shown, one whole section being given up to a display showing sections of walls and ceilings finished in colors. In this building an effect, which should be seen to be appreciated, was reached by the handsome wall display of the Shurley & Dietrich Co., of Galt, of their saws and tools, this company securing the Gold Medal award. The machinery exhibits were also of great interest, that of the Canada General Electric Co. and Canada Foundry Co. being particularly fine.

The last of the three new buildings is known as the Western Section and contains a very full list of exhibits, in the main covering domestic supplies. The general effect in this building is one of splendour, the booths being chiefly in the brightest of colors, in canopy or enclosed form, and a large number illuminated by electric lamps. To select any for particular notice would be a difficult undertaking, the Gold Medal awards for excellence, being granted to J. W. Hammond (furs) and the Winnipeg Rubber Co. An exhibit which attracted the special attention of sportsmen was that of the Pearson Boat Construction Company, for whom Messrs. McCullock & Boswell are agents. Here were exhibited several very fine gasoline launches, fitted with dynamos for light and ignition, all of which, we understand, were sold during the show. There were also on exhibition, several automobiles by the Canada Cycle & Motor Co., one of which waselectric, and the remainding gasoline. A very fine electric lighting display was that of the E. S. Harrison Co., Limited, of Winnipeg, which attracted much favorable comment.

The remaining buildings are those given over to the cattle, horses, etc., which never fail in their attractive power, and this show has proved itself by no means behindhand, the show-ring being daily a source of great interest.

The current for lighting the Exhibition has been supplied from the city plant, and all details and arrangements in connection therewith handed over to the E. S. Harrison Co., Limited.

THE WINNIPEG RUBBER COMPANY, LTD.

The western selling agents for The Gutta Percha & Rubber Manufacturing Co., of Toronto, has an excellent display of subber goods, with a special show of their well-known brands of belting and hose, foremost among which is their "Maltese Cross" special stitched belting, made particularly for dynamos and mill purposes. Their other brands, viz : Monarch, Red Strip, and Lion Brand are also well in evidence. Their display of fire hose made under the various brands of "Eureka," "Paragon" and "Red Cross," is also very attractive. The brand known as "Guttaperch," we understand, is a make of special excellence, and has been approved by the Board of Underwriters, it being especially antiseptically treated and made particularly to meet the most severe requirements. The company have also a "Red Stone" and "Blue Stone" brand of high pressure steam packing which has always given the highest satisfaction in use. The Company is one of the largest manufacturers in Canada in these lines. A gold medal for excellence of display has been awarded them.

THE ALLIS CHALMERS-BULLOCK CO., LTD.

of Montreal, have a prominent centre stand, in the Machinery building, where they are displaying several of their machines of special interest in Manitoba and the North West. This company is establishing an office in Winnipeg, with a permanent, resident representative, in order to cope with the increasing demands of the North West.

THE TORONTO & HAMILTON ELECTRIC CO., LTD.

are showing a range of direct current induction motors and generators for lighting plants. They have also on exhibition a gasoline engine, emery stands and general blacksmith outfits. This company carries a full stock of electrical goods in Winnipeg at No. 152 Henry ave., the address of their agents, Messrs. Burridge & Cooper.

DOMINION EXHIBITION, WINNIPEG.—EXHIBIT OF THE WINNIPEG RUBBER COMPANY.

THE PENBERTHY INJECTOR CO., LTD.

of Windsor, Ont., have a very fine display of their Penberthy Injectors, connected and arranged to form a barrier rail to their space. They have also a series of stands showing every size and pattern made. An interesting feature of this exhibit is a machine in full operation for making the Penberthy Injectors; for this purpose one of their skilled workmen has been brought from their works, and has been daily at work with the machine, taking the injectors from the rough casting and completing and making them in the presence of the visitors. With the exception of perhaps one or two, all the machines at work on the grounds are fitted with this company's injectors It is of interest to note that this is the only exhibit in the Exhibition shewn in process of manufacture.

THE ERNEST S. HARRISON CO., LTD.

of 246 Portage ave., Winnipeg, have a display at once costly and of particularly pleasing effect, draped in gold and white, with art curtains at each end and furnished with upholstery to blend, giving the impression to visitors of entering a comfortable library than a show space in an exhibition. The ceiling is most artistically arranged with a variety of lights, a magnificent centre dome light, fancy hanging domes, cut bevel glass hangers, bent glass hangers, and other designs, whilst the walls are decorated with three panels containing respectively a line of knife switches, tablet boards and cut-outs, a full line of bells, annuicators and telegraph instruments, and wall lights of a great number of designs. A Bronze Medal award has been given to the Company for their fine display. This Company has had charge of all the electric light fittings and arrangements in connection with the Exhibition.

CANADIAN GENERAL ELECTRIC COMPANY, CANADA FOUNDRY COMPANY.

The largest space in the Machinery Building was occupied by the Canadian General Electric Co., and Canada Foundry Co., of Toronto, their exhibit consisting of four carloads of electrical machinery and foundry products covering a space of 130 feet by 11 feet. The exhibit was most admirably displayed and gave the visitor some idea of the vast range of products made by this Company.

Starting at the entrance of the building first appeared the waterworks supplies consisting of hydrants, valves, valves boxes, and special castings, then followed a line of the well known Northey pumps, boiler feed, single and duplex, jet condensers, sinking pump, power triplex pumps and centrifugal pumps, followed by drinking fountains, hitching posts, lawn rollers, and seats.

A large and imposing pyramid of set screws and nuts next caught the eye, of which the variety was a surprise to even those mechanics who are constantly using them.

The products of the Subway Works were shown by a superb teller's cage finished in matt Copper with a counter railing of handsome design in a like finish, samples of electro plated finishes were shown in endless variety. A very choice selection of wrought iron andirons, fenders and fire screens attracted much attention.

In the office were displayed views of the different factories and descriptive matter and information were dispensed to all interested.

The remainder of the space was devoted to the electric interests and here the attention of the wireman was fixed as he looked with envious eyes on the display of electric supplies in such a variety as had before been unknown to him.

The ladies' attention was arrested by a display of electric cooking and heating apparatus.

This was followed by a complete line of direct current motors from 2 h.p. to 35 h.p. one being shown in operation driving a generator supplying current for the exhibit, among other things to a number of meridian lamps which received universal admiration.

A full line of transformers was displayed together with the core and coils used in their manufacture, demonstrating the method of insulation used in the manufacture of the well known Type H.

A handsome marble switchboard formed the background.

Next appeared a Curtis electric truck equipped with C. G. E. 67 motors and standing near by were two K 10 controllers with the cover off disclosing the mysterious working parts.

On the wall was arranged a neat display of armature and transformer punchings and armature coils insulated ready to be placed in the machines.

In an annex further down the aisle was shown an S.K.C. 150 k.w. generator and a "Tub" transformer for series arc lighting. The whole forming a display calculated to impress one with the conviction that Canadians have in their midst a source of supply in electrical and mechanical engineering lines, equal to anything on the American continent.

A successsful test of peat fuel was made on the night of August the 4th in the furnace of the Electric Car Company's station at Yarmouth, N.S. This coke had been perfected largely through the agency of Malcolm Booth, and in the test made demonstrated its intense heat giving powers. Ten minutes after the first supply was put in the furnace the drafts had to be closed, and for several hours the pressure was maintained at 100 lbs. The heat was intense, the peat burning with a clear flame and giving out almost no smoke, while the coke practically burnt away to fine ashes.

DOMINION EXHIBITION, WINNIPEG.—EXHIBIT OF THE PENBERTHY INJECTOR COMPANY.

THE TORONTO AND NIAGARA POWER DEVELOPMENT.*

By K. L. AITKEN,
Chief Engineer The Electrical Supervision Society,
Toronto, Ont.

Entered according to Act of the Parliament of Canada, in the year one thousand nine hundred and four, by K. L. Aitken, at the Department of Agriculture.

In 1883 the Toronto Electric Light Co. started business with a couple of small arc machines, the total capacity of their plant being in the neighborhood of 50 lamps. Ten years later, The Toronto Railway Co. commenced to equip their road with electricity, and as can be readily understood, the first plant installed was on a larger scale than the lighting company's, having a rating of about 1,880 kilowatts.

To-day we find that conditions have changed materially, for the Electric Company's plant has a normal output of 5,000 K.W., with the peak of their load running as high as 7,500, and the Railway Co. has generators and storage batteries installed, or being installed, so that a one-hour rate of discharge of 8,200 K.W. can be maintained without taxing the generators beyond their normal capacity.

Taking these figures into consideration, it is not difficult to arrive at a certain conclusion, namely, Toronto, as a manufacturing city, has recently experienced great development. This has been due almost entirely to its central location, and to its shipping facilities, and not because cheap power was obtainable. The geographical conditions which surround the city are ideal for expansion, and therefore, considering the great advances which we have made, under adverse conditions, it is safe to assume that with cheap and unlimited power available, the growth of the city, as a manufacturing centre, would be simply enormous.

These facts have been patent for some time, and it is, therefore, easily understood how the Niagara Power scheme came into existence. Before any definite steps were taken, the matter received considerable attention, for there were many obstacles to be overcome. Almost all the points raised, however, have been cleared up, and we have to-day the Electrical Development Co., whose charter calls for the development of power at Niagara Falls, Ont., and the Toronto and Niagara Power Co., which will transmit and distribute the power generated.

It is the object of this paper to set before you a rough and general outline of the work accomplished by the above companies. While gathering the information which is herein contained, a number of items, pertaining to the works of the other companies operating at Niagara, came under the writer's attention, and have been embodied in this manuscript, with the hope that they will be found of interest.

On January 29th, 1903, an agreement was entered into between the Commissioners of the Niagara Falls Park and Messrs. Mackenzie, Pellatt and Nicholls, this agreement giving these gentlemen the right to take water from the Niagara River, at Tempest Point, for the purpose of generating electricity to the extent of 125,000 electrical horse power.

On February 18th, 1903, the Electrical Development Co. of Ontario was incorporated, and this company took over the agreement just mentioned. As soon after this date as possible, plans were drawn up and contracts for various portions of the work let, so that, practically speaking, no time has been lost in expediting operations since the formation of the company.

The Treaty of Ghent fixes a boundary dividing the waters of the Niagara River into two portions of national ownership. Gaugings of the entire discharge of Lake Erie into the river, made by the United States Government, indicate that the low-water flow is somewhere in the neighborhood of nine million cubic feet per minute. From an examination of the velocity of the water along the Canadian shore, and based upon the depth, it is estimated that a larger percentage of the total flow (possibly 65 or 75 per cent.) is owned by the Canadian Government.

The selection of the site of the power house was attended by a careful study of the conditions which have existed for the last six years in heavy water power installations, and particular attention was given to the plants in operation and under way, both on the American and on the Canadian sides of Niagara. Most of these installations have been made on a very large scale, and due consideration was given to the experiences of all the companies.

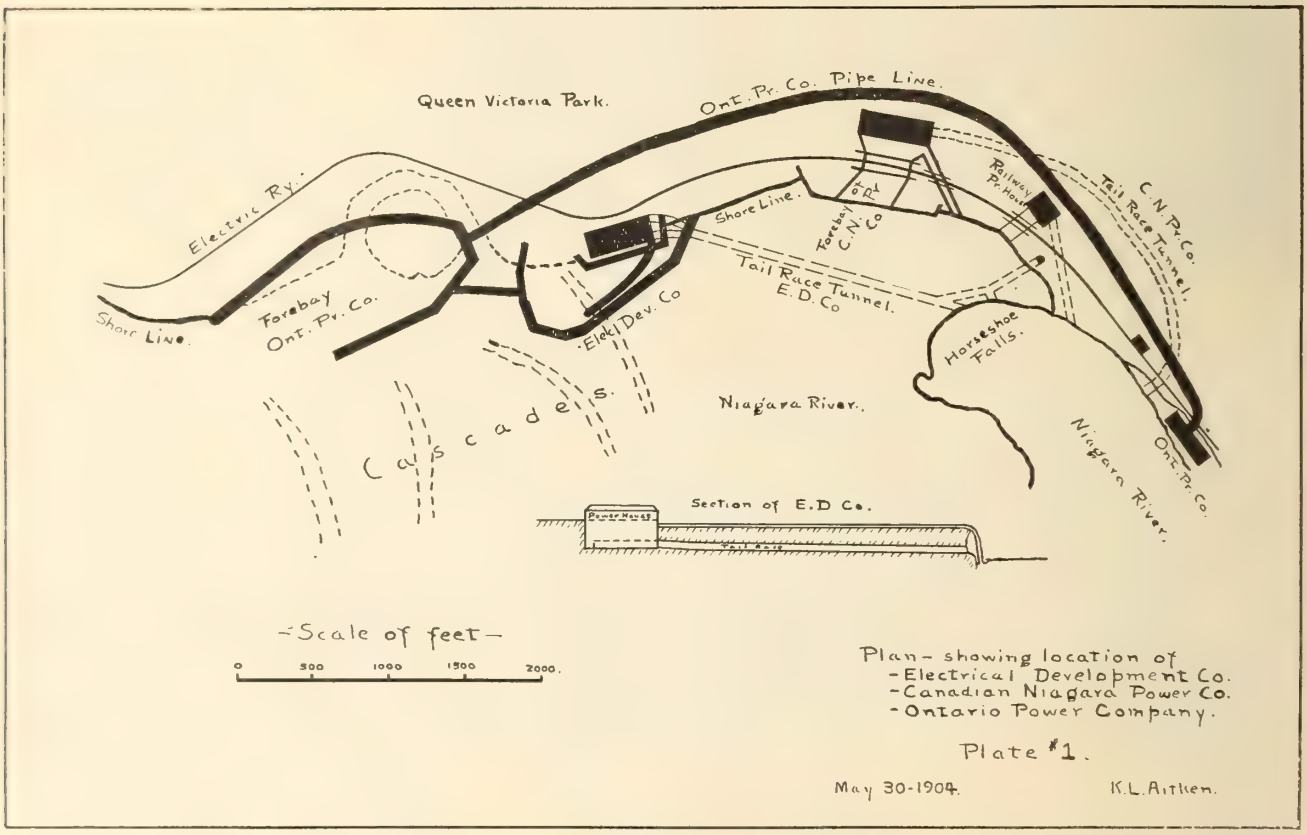

Plate 1.

The construction of a deep vertical wheel pit, and the discharge of water therefrom by the use of a low-level tunnel, having been demonstrated as successful designs, and applicable to the geological conditions existing at Niagara, it was decided to lay out a power house using these principles. The point selected for the site seemed to lend itself particularly to this form of construction, as it was located sufficiently far from the edge of the falls to remove it from the constant humidity which is always in evidence, and still not so far as to make the cost of the tail race tunnel prohibitive. The site also provides an easy method of handling the ice which comes down the river, and this is one of the serious conditions which have to be dealt with at Niagara. There has been very little anchor ice noticed along the Canadian shore, although some difficulty has been experienced from this source on the other side. Last winter, The Niagara Falls Power Co. on the American side had trouble from the ice, as their intake is in practically still water. This water, being only six to eight feet deep, froze solid for a distance of 1,500 feet from the shore, and two tugs had to be constantly employed to keep a channel open so that water would come into their penstocks. As it was, the output of the station was considerably reduced, but this trouble is not expected to happen again, as it is hardly likely that we will experience another winter with such continued low temperature. But even so, the American company will know what to expect, and will take steps to keep a larger channel open.

Before taking up the hydraulic end of the Electrical

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* Paper read before the Canadian Electrical Association.

Development Company's plant, it may be interesting to state, so that you will have a clear conception of the size of the installation, that the generator equipment will consist of eleven units, each having a normal rating of 12,500 horse power.

Plate 1 is a rough drawing indicating the works of the Electrical Development Co., The Canadian Niagara Power Co., and The Ontario Power Co. Starting on the extreme left, we have the forebay of the Ontario Co., the mouth of which is above the first cascade. From this forebay, which is a most extensive piece of concrete work, there will run three steel pipes, just below the level of the ground. These pipes will be 18 feet in diameter, and will be made out of half-inch stuff, the capacity of each being 50,000 H.P. At a point somewhat below the Table Rock House, these three main pipes will branch into seven penstocks each, and these penstocks will run down through the ground to the level of the turbines, where they turn at right angles and run direct to the wheels. The power house will be built on the extending ledge of limestone at the foot of the cliff, and the draft tubes, I presume, will discharge into the river below the level of the water. In designing these three big pipes many difficult problems must have been encountered.

Plate 2—Interior of one of the 18 foot Steel Pipes.

Consider, for example, what will occur when a short circuit comes on the line. Let us suppose that the short is on the line itself, and that as a result a couple of wires come down. Suppose that the big generators that are pumping into this line are taking water from one of the pipes. When the load is thrown completely off, the action of the water wheel governors will be to almost entirely shut off the supply of water. Now, when you have a body of water 18 feet in diameter, and something over 6,000 feet long, moving with a velocity of 13 feet per second, and you endeavor to throttle this water, something is likely to happen. I understand that an overflow will be constructed to take care of such emergencies, though just what the arrangement will be, I could not ascertain.

The construction of the Canadian Niagara Power Company's plant will be clearly understood from Plate 1. We have the forebay, the deep vertical wheel pit, and the low-level tail race tunnel discharging at the river level, and close to the power house of the Ontario Co. The forebay is of stone, and very strongly built.

In front of the penstock openings will be built a line of submerged ice arches, the object of which will be to prevent ice from entering the screen room which will be constructed between the penstocks and the arches.

From Plate 1 you will see how this is worked out. There is an opening built at the inside down-stream corner of the forebay which leads out to the river again. This channel is only about ten feet wide, and the difference in head between the mouth of the forebay and the outlet of the channel is not much more than four inches, which will not produce a very rapid flow of water.

Plate 3 shows the inside of the forebay, the ice arches which are built, and also the opening into the ice channel.

The power house of the Electric Railway Co. is located just below the plant last described. This equipment I did not examine, but information was given to the effect that as the amount of power required was very small, very few unsolvable problems were encountered during its construction. The available head was not used, as the discharge tunnel comes out at a point about half way up the cliff. Taken as a whole, this power house presents a very pleasing appearance.

Upon completion of the plans of the Electrical Development Co., the first step to be taken was the removal of the water which covered the site of the power house and wheel pit.

At the time this work was commenced, it was recognized by all those conversant with the plans, that the greatest difficulties that the company would have to encounter would be in the installation of the coffer dam, and the commencement of work on the main tail race tunnel. It was considered by many that it would be impossible to carry out the work as outlined on the original plans, and it is certainly to the credit of the engineers that these difficulties have been successfully overcome.

It was assumed in the original estimates that the depth of water would be about eight feet, as a maximum, on the line of the coffer dam, and in view of the fact that this dam was to be located in the midst of the rapids of the Niagara River, it was expected that it would be a difficult operation to build a structure that would withstand the excessively rapid current. As the work proceeded, and it became possible to ascertain the depth of the river, it was found that in certain sections there was 26 feet of water, and not eight as originally figured upon; but in spite of this fact the dam was successfully placed in position. Besides the deep water, another difficulty was encountered in the setting of the dam, namely, the irregularity of the river bed. An immense number of boulders and fissures, of all shapes and sizes, was found, and upon this foundation the structure had to be built. Besides the actual setting there was the work of making the dam watertight. When I visited the site recently, I found this matter in very good shape. The upper part of the enclosure is entirely dry, but down in the lower part of the dam there are two bad leaks. These, however, have been located, and divers are at work in the puddle spaces, and so it is only a matter of days or weeks before the dam is in first-class shape. In walking over the structure, I was impressed by its solidity, not the slightest vibration being noticeable.

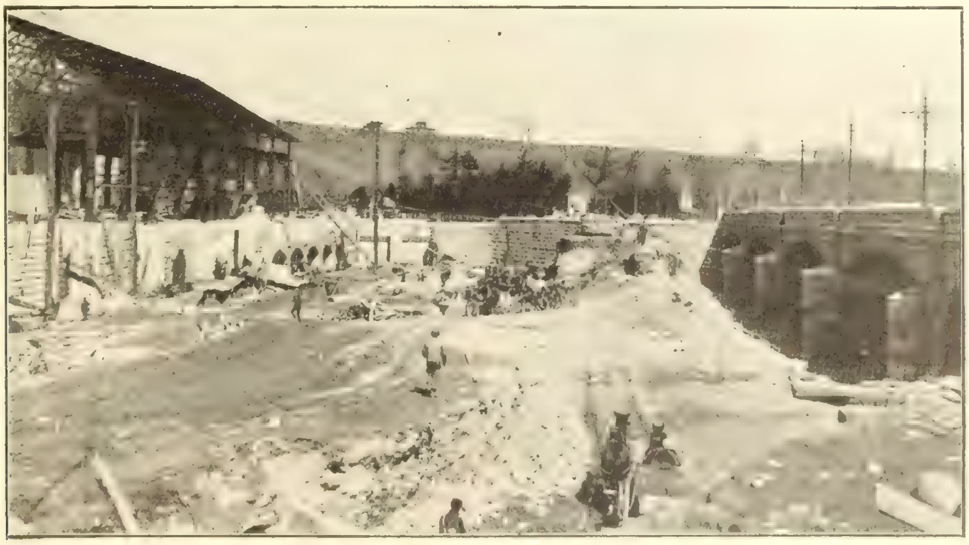


Plate 3.

The plan for the tail race tunnel required a portal under the falls. There have been various theories regarding the condition existing behind the sheet of water, as there are, at short intervals, noticeable explosions, apparently due to compressed air; and it was confidently predicted by engineers conversant with Niagara Falls and the work thereabout, that it would be impossible to open a tunnel portal at the point selected on the plan.

These compressed air explosions are quite in evidence, for if you take the trouble to watch at the brink of the Horseshoe, at about the centre, you will see the spray make a sudden and decided shoot into the air, at intervals varying from a few seconds to half a minute. The generally-accepted explanation of this was that there was a large chamber formed by the cliff and by the curtain of water, this chamber being considered airtight. As the water passed over the cascades above the fall a large amount of air was taken into it, in the form of small bubbles, and when the edge of the falls was passed, a certain portion of this air was liberated on the chamber side of the sheet. Thus the pressure was gradually raised until it was sufficient to break through the curtain, and produce the sudden puff above referred to. The idea is erroneous, and has been proved so by the opening under the falls being made. The condition which exists is entirely normal, and the chamber is not airtight, and never has been so far as can be ascertained; and besides, the explosions still occur. That air is carried over the falls in the form of bubbles and liberated on the inner side of the curtain, I believe to be perfectly true, for there is a constant flow into the tunnel, and it gives one the impression of having been "water washed." It is really, without exception, the purest and sweetest air I ever tasted.

Mr. Beverly R. Value, the Resident Engineer of the company, gave me a very acceptable explanation of these explosions. If you will refer to Plate 1 you will notice a curious formation of the crest of the Horseshoe Falls. At one point the water folds in upon itself. Mr. Value thinks that as the volume of water at all points on the crest is constantly changing, that at times an opening is formed in the centre of this fold, and that in this opening there is naturally a body of air. Then the volume of water increases, and this air is confined, carried down with the water and compressed to a certain extent. When the water strikes the rocks below and breaks, this air is perhaps given an extra squeeze, and then liberated, thus producing the puff of vapor.

In order to start work on the lower end of the tail race tunnel, and drive back to the wheel pit, a construction tunnel of about 650 feet in length was required, and to ascertain the conditions under the falls, as well as to provide for dumping the debris of excavation, an opening was planned about midway of this tunnel. It was anticipated that some trouble might be caused by the water when this was made, and the anticipations were more than borne out by the facts, as long before an opening was effected, the tunnel was flooded by water which leaked in through cracks in the face of the cliff. For several weeks great trouble was experienced in overcoming this difficulty, but finally, after persistent work, an opening was made, which completely drained off the water, and proved that it was perfectly feasible to place the terminal of the main tail race tunnel at the point originally planned.

I might say, at this point, that the rock encountered under the falls is solid shale, and that it is absolutely dry. Mr. Value made a statement about this fact some months ago, at a meeting of engineers at New York. The remark was laughed at, for it seemed to these men a condition which could not possibly exist under the bed of such a river as Niagara. The statement made was to the effect that the tunnel was so dry that water for the drills had to be obtained at the opening under the falls, and carried back to the spot where the men were working. This is absolutely true, and the dryness is evidenced by the fact, that when I was down in the tunnel, I put my hand up against a portion of the timbering, and drew it away covered by dust.

With the coffer dam built, and the tunnel started, the two great problems have been solved, and from this point the work has been all plain sailing.

Plate 4.

I show here a photo taken inside the main tail race tunnel, illustrating the method of timbering. About 1,000 feet of the tunnel has been driven, and progress is being made at the rate of 50 feet a week. It is expected that work will commence at the upper end in the near future, and that the two will meet about October 1st of this year

When the dam had been run out into the river for a distance of about 600 feet, the depth of water increased to almost 24 feet, and as can be readily understood, the effect was decidedly severe, as the direction of the flow was at right angles to the end of the dam.

In order to break the force of the current, a fender was constructed of heavy timber, and placed against the upstream side of the cribwork, projecting beyond the last crib in place. This fender was held by three steel cables, passing along the outside face of the spur, where a winch was established to control the lines used in paying it out. The cribs were framed in the slack water below the dam and brought into place by means of stout tackle.

At a distance of 690 feet from the shore, the strain on the fender was so great, that the cables parted, and it was carried down the river, where it stranded about 150 feet from Tempest Point.

A new fender of heavier design was constructed, which served its purpose until the first cascade was reached. In attempting to move it over the cascade, it was broken to pieces by the force of the water, and carried over the falls. At this point, however, the cribwork was running nearly parallel to the flow, and so no great difficulty was experienced in placing the cribs without its assistance.

Plate 5.

Plate 5 gives an idea of the river bed. The whole area which has been drained presents the same irregular appearance.

As the site of the wheel pit was not entirely unwatered by the main dam and as it was desirable to start work on the pit at the earliest possible moment, an inside dam was constructed. As the water in which this was set was practically still, no great difficulty was experienced in making it tight.

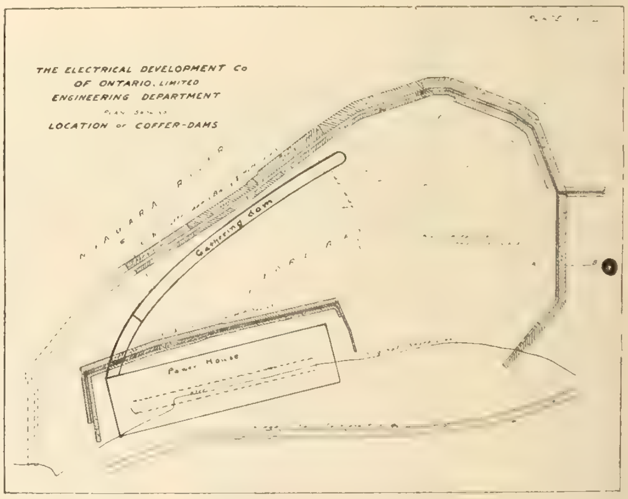


Plate 6.

I have sketched in on Plate 6 the outlines of the power house and the gathering dam. The dam will be constructed of cut stone and concrete, and from the upstream end down to a point about 150 feet from the power house, its top will be approximately level with the water. For the last 150 feet, the top of the dam will be about four feet below the water. Along the side of the power house will be built two rows of submerged ice arches, behind which will be located the screens. From this construction it will be seen that there will be a constant and heavy flow of water along the line of the arches, and that, therefore, any ice which is taken into the dam will be carried rapidly to the lower end, and discharged into the river. This scheme has been approved of by a number of prominent engineers, and I must say that on the surface it appears to be a very good idea.

I stated some little time ago that in order to start work on the main tail race tunnel a construction tunnel had to be built. As this was one of the first steps to be taken, and an important one, I wish to devote to it the time it deserves.

When the construction shaft had been sunk some little distance, considerable trouble was experienced from water, the rock pierced being badly disintegrated. It was, therefore, necessary to concrete this shaft, and this remedy has proved fairly effective. There is some water coming in yet, but it does not amount to more than a gentle rain, and one small pump (the only one in the whole of the underground works) is sufficient to take care of it.

The shaft has a depth of 150 feet, and then turns and runs out under the river. At a distance of 385 feet from the shaft, the cross drift leading out under the falls was begun.

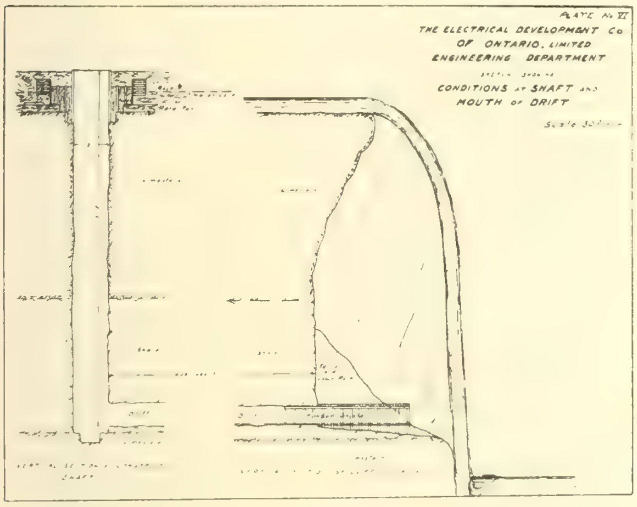


Plate 7

Up to this time, the tunnel had been absolutely dry, but when the cross drift reached a point about 14 feet from the face of the cliff, a fissure in the roof developed, through which water came in considerable volume, flooding the tunnel, and causing a suspension of work. Pumps were installed and the water was lowered, but as preparations were being made for a blast, a portion of the roof collapsed, and a larger flow took place, again flooding the drift.

It was found that the water rose in the shaft to a height of 16 feet above the grade of the drift, before finding its level, thus indicating that it came from the spray under the falls, through fissures, whose openings were approximately at this level. This inference was completely borne out by subsequent examination.

A heavier pumping plant was installed, and the water lowered, thus allowing work to proceed. Holes were drilled in the face, varying in length from 18 to 22 feet, indicating a barrier of solid rock of about 12 feet in thickness, and beyond this a softer rock somewhat disintegrated, but of unknown thickness, none of the holes penetrating to the face of the cliff. In all, 18 holes were drilled, and as the flow into the drift was increasing in volume, and gaining on the pumps, it was decided to load the holes and blast away the barrier. In addition to the dynamite used in the holes, ten cases of the explosive were placed at the face of the cross drift, and the drift was allowed to flood before firing.

The blast broke down the solid rock barrier and opened a cut through the disintegrated rock and talus, out to the sheet of water, and down to an elevation about 12 inches below the drift roof.

The water fell to this level, and several efforts were made to reach the opening by means of a boat, in order to blast away the remaining barrier and allow the water to flow out. A trip was made in this manner, by three of the miners, and three cases of dynamite were placed in the most effective position, and fired. The blast tore a big hole in the rock, but did little or nothing towards removing the mass which prevented the water from escaping.

Failing in this attempt, two of the foremen successfully made the trip around behind the falls, to the mouth of the drift. Starting from the Scenic Tunnel, these men, roped together, crept along the top of the talus for a distance of 450 feet, at which point they found the opening. A number of trips were made in this manner and a large amount of dynamite (in all, some 8,000 pounds,) was carried out back of the falls, and used in open blasts, making a large opening down to the level of the drift floor, and thus establishing complete drainage.

Mr. Value was one of the men to make the second trip over the talus behind the falls, and the description which he gave me of his experience was decidedly vivid. There seems to be a backlash of the water at the foot of the falls, occuring at irregular intervals, and coming without warning. This is one of the inconvenient happenings of the trip, but there is little or no danger of the men being washed off the rocks, as the tendency is to beat them down. Besides this there is the constant spray. The word "spray," when used in connection with the condition which exists under the falls, has a meaning of its own. From what I could see from the end of the cross drift, it appears to be a solid mass of water coming from above, below, and from all sides, and backed up by a very strong wind. How the men managed to withstand this, I don't know, but Mr. Value told me they looked somewhat damp and also felt damp when they got back to the Scenic Tunnel. He himself had on rubber boots, rubber trousers, an oilskin coat, with the arm openings strapped tight, and a waterproof hood, which left only the face exposed, and fastened tightly around the neck. In spite of these precautions, when the first backlash came, it finished any spots which the spray had overlooked.

A case of dynamite, when placed in position, had to be chained in place to prevent its being washed away. Another nice feature is that rocks of all sizes are constantly coming over with the water, and this made the work particularly hazardous. One case of explosive had just been made ready for firing, and the men were about twenty feet away, when a good-sized stone dropped square upon the middle of it. Luckily the primer was not disturbed sufficiently to cause an explosion, although the case was split to pieces and the dynamite scattered.

At the opening of the cross drift, a heavy timber shield, made of 12 x 12 stuff, has been erected, to protect the workmen from the spray. This shield has been closed up as much as possible, the only large opening being a hole about three feet by six feet in the floor, through which the rock taken from the tunnel is dumped.

When I made the trip down into the underground works of the company recently, the thing which impressed me most was the clean and orderly arrangement of everything. A short distance from the foot of the construction shaft, is what Mr. Hoyles, of the Engineering Staff, called the "racing stable." While life below may not be very pleasant, still I saw, in this particular tunnel, practically no evidence of discomfort. From this point we proceeded along the tunnel, past the cross drift, and into the main tail race tunnel. This had not yet been cut out to the falls, but the men were at work making an opening. About 12 feet of rock remains to be removed. A number of drill holes extended clean through the barrier, and through these daylight could be seen.

Plate 8.

(Since completing the original of this paper I have been informed that this opening has been made, and that things are in a better condition, generally, than was expected. There is no projecting ledge below the cliff at this point, and consequently no trouble from loose rock will be experienced.)

We proceeded from this point to the other end of the tunnel, and stayed there for some time examining the timbering and the method of drilling. On our return, we had traversed about half the length of the tunnel, when a blast was fired at the lower end. The sensation was peculiar, to say the least, for we were at close range, and in a confined space. There was a sudden rush of air, and our candles went out, and this was accompanied by a strong and involuntary desire to lie down.

When we emerged from the top of the shaft, I wanted to get a picture of the head gear, and so intrusted a friend with my camera. Messrs. Hoyles and Aitken were to be around, of course, but were not intended to play a prominent part. Upon developing the film, I found that it was mostly Hoyles and Aitken, and very little head gear, for which I beg to apologize.

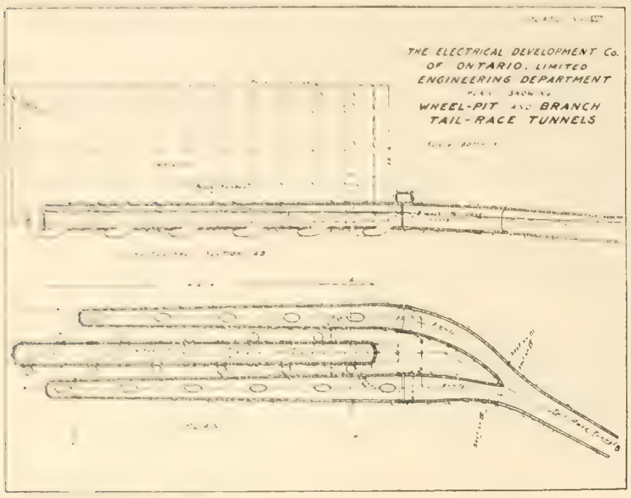


Plate 9.

The wheel pit is designed for an installation of 11 turbines, and the tail race tunnel comes up to a point 165 feet from its lower end, there branching into two lateral tunnels, which pass on either side of the pit. The intervening rock is pierced at intervals by draft tubes, which enter the tunnels through the invert, a water seal thus being preserved at all stages of operation. Single draft tubes are used, and each alternate wheel discharges into the same tunnel, six tubes entering the north tunnel, and five the south. Gates are provided for each side tunnel, so that it is possible by closing either gate, and shutting down the wheels discharging into this branch, to make an inspection while the other half of the station is in operation.

The water which is taken in by the gathering dam, will be conveyed downward through steel tubes to the wheels located at the bottom of the pit, and the difference of level provided by the design is such, that, after deducting all losses due to friction, etc., there will remain an operating head of 143 feet. There will be two wheels on each shaft, the penstock entering between them. The old idea of having the top wheel somewhat larger than the bottom, having proved satisfactory, the same arrangement will be used, and the upward thrust thus produced will be just sufficient, at a predetermined gate opening, to balance the weight of the shaft and the revolving part of the generator above.

The wheel pit will be provided with a masonry lining, and the provision that the turbines and all of the machinery above them shall rest on solid rock foundations, instead of artificial supports, as has hitherto been the practice, is an element newly adopted for this construction, the value of which is self evident.

The 11 generators will be installed on masonry foundations at the level of the power house floor, and the connections between them and the turbines will be made by use of hollow shafts, travelling in a vertical position, having a total length of approximately 115 feet, and supported at three intermediate points by solid masonry bearings. There will be one thrust bearing on each shaft, located just below the generator.

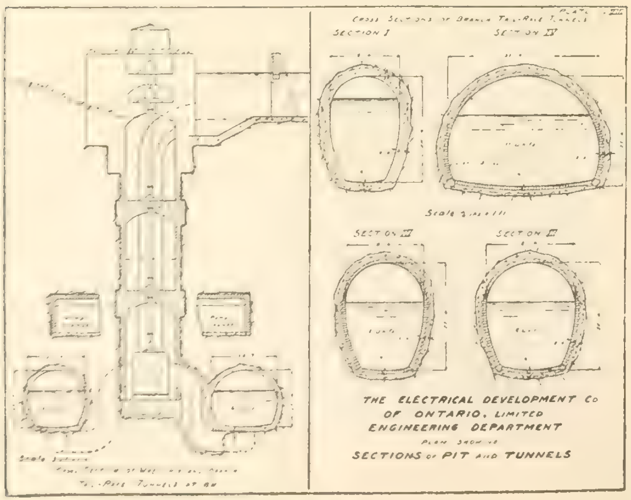

Cross Sections of Branch Tail-Race Tunnels
SECTION I
SECTION IV
Scale
SECTION II
SECTION III
THE ELECTRICAL DEVELOPMENT Co
OF ONTARIO, LIMITED
ENGINEERING DEPARTMENT
SECTIONS OF PIT AND TUNNELS

Plate 10.

On the right hand of Plate 10 are shown four sections of the tunnel. These sections are marked I, II, III, IV, and GH, and the corresponding numbers and letters will be found on Plate 9.

The two elements of placing the labor of supporting the turbines, etc., upon solid rock foundations, and the provision of masonry intermediate supports for the shafting, are a departure from previous practice, but have been adopted in order that the serious element of vibration in heavy revolving machinery may be reduced to an absolute minimum.

The water, after passing through the turbines, will be discharged through steel draft tubes to the two branch tail race tunnels, connecting with the upper end of the main tunnel. This design is also a departure from previous practice, but has been adopted for two important reasons. In the first place, it is not to be assumed that machinery can ever be installed as to remove the necessity of future repair, and in the second place, by the use of two branch tail race tunnels, it will be possible at any time to close down one half of the station and make necessary repairs, without the other half of the plant being interfered with. In other words, the use of this double design makes in practice two stations out of one, each half being absolutely independent of the other. This provision is also important because in active operation it is always desirable to make frequent examinations of the machinery, in order that the beginning of trouble may be discovered before serious damage has been done. Another feature of the method of discharge is that the turbines themselves will always be accessible and not submerged at times, as in the case of some of the other plants.

In the first power house built on the American side, the turbines discharge at the bottom of the wheel pit into the open air, so that at all times the pit is very wet, owing to the spray. In the second power house draft tubes are used, and the general condition of things is better, but the scheme is such that the tail race tunnel opens into the wheel pit, the draft tubes only preventing the throwing of water, and also giving an increase in operating head. In neither house is there any means of preventing the wheel pit from flooding, in case the water backs up in the tunnel. In the case of the Electrical Development Co. this is impossible with the construction used, and although it appears to be a much better design, I understand that the Canadian Niagara Power Co. is using the same principles as the No. 2 power house on the New York side.

It has occurred in the Niagara River, below the falls, that jams of ice have temporarily caused more than 50 feet of an increase in the ordinary high water level below the falls. If such a condition should exist when the Electrical Development Co.'s plant is in operation, the only result will be a reduction in the operating head during the temporary period, and not a filling up of the turbine chamber.

The water, after it is delivered to the branch tunnels, is by them delivered to the main tunnel, and is carried by means of this in a straight line and with a grade of five and a half feet per thousand to a point of discharge behind the main sheet of the falls. This tunnel, in being straight, will be free from special erosion to its lining due to a change in direction of rapidly-moving water, and the character of this lining will be such as to practically preclude the possibility of depreciation.

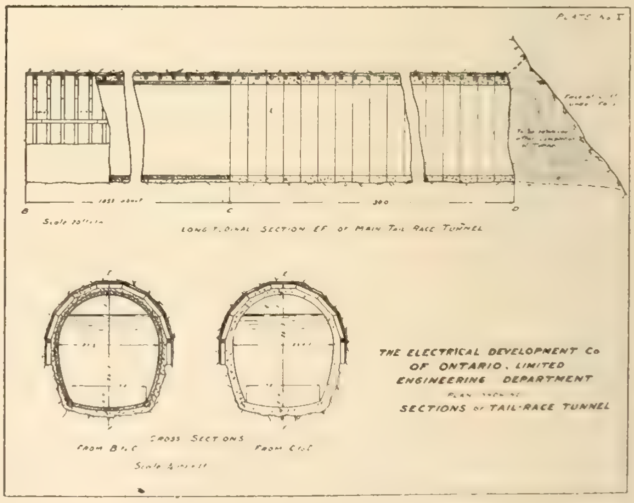


PLATE No. V
300
B
C
D
LONGITUDINAL SECTION EF OF MAIN TAIL RACE TUNNEL
THE ELECTRICAL DEVELOPMENT Co
OF ONTARIO, LIMITED
ENGINEERING DEPARTMENT
SECTIONS OF TAIL-RACE TUNNEL
CROSS SECTIONS
FROM B TO C
FROM C TO D

Plate 11.

A point which has been considered in the building of this lining, is the fact that the Horseshoe Falls are constantly receding, and therefore, for a distance of 300 feet from the lower end, the lining will be constructed in rings, six feet in length, so that, as the falls recede, it will drop off in uniform sections, thus preventing cracking back of the portion shortened. The lining for the 300 feet mentioned, will consist of concrete, and for the balance of the distance to the wheel pit, two rings of hydraulic pressed brick will be used, backed solid to the rock with concrete.

A light steel observation gallery will be placed in the tunnel, running its entire length, by use of which it will be possible to make frequent examinations of the lining, etc.

From Plate 11 you can get the dimensions of the main tail race. With full load discharge the water will come approximately to the level indicated, and will travel with a speed of 27 feet per second.

Plate 12—Wheel pit, May 4th, 1904.

Referring to the section in Plate 1 you will notice that the grade of the tunnel is sharper for the first three or four hundred feet. The water receives its initial velocity at this point, and the grade of the balance of the distance, namely, five and one-half per thousand, is sufficient to maintain this speed.

I stated at a previous point that the minimum discharge from Lake Erie into the Niagara River was about 9,000,000 cubic feet per minute. It may be interesting to note that the total water required by the new power house, when operating under full load, will be in the neighborhood of 700,000 cubic feet per minute, or about 7.7 per cent. of the minimum flow. Figuring from this, we find that the total horsepower at the Falls is in the neighbourhood of 1,620,000. There is a prevailing idea that the water which passes down the river represents about 5,000,000 horsepower, and no doubt this figure is arrived at as follows :—

The difference in elevation between Lake Erie and Lake Ontario is 327 feet. Assuming a minimum flow of 9,000,000 cubic feet of water per minute, and that the weight of one cubic foot of water at 62 degrees Fahrenheit is 62.335 lbs., we get a total weight of 561,015,000 lbs. per minute. This, when multiplied by the difference in level of the two lakes, namely 327 feet, gives 183,451,905,000 foot pounds, which, divided by 33,000, gives approximately 5,500,000 horsepower. Of course, in this no allowance is made for frictional and other losses, the entire difference in elevation being used. In the Decew Falls plant, I understand that a head of 270 feet is available, which goes to show that it is practical to use a much greater head than that obtained by the Companies operating in the immediate vicinity of Niagara, but with this must be considered the fact that these latter installations are on a much larger scale, and that therefore the problem of handling a much greater volume of water presents itself.

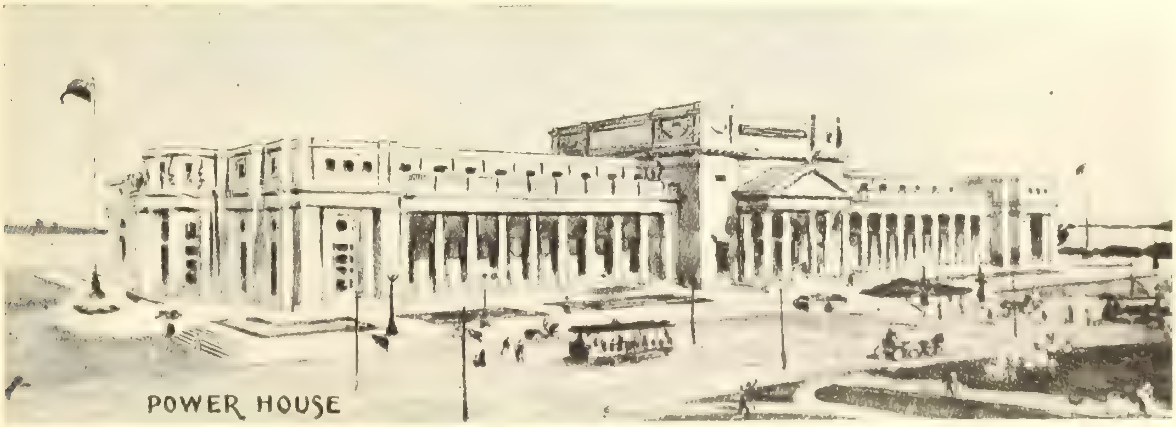


Plate 13.

Below are given a few figures in connection with the underground work :—

Depth of Construction shaft, 150 feet.
Length of Construction tunnel, 670 feet.
Length of main tail race tunnel, 1,935 feet.
Length of each branch tail race tunnel, 550 feet.
From power house floor to bottom of wheel pit, 158 feet.
Length of wheel pit, 416 feet.
Width of wheel pit, 22 feet.

In regard to the hydraulic work, there is not much more to be said, beyond the fact that the use of perishable material has been absolutely prohibited throughout, and that all inaccessible parts have been so designed as to be without need of future repair.

In the agreement which was made between the Commissioners of the Niagara Falls Park, and the Power Syndicate, it was stated that the power house should be of such design as not to detract from the appearance of the park in any way. Plate 13 will give you a general idea of what the building will be like, as this design has been submitted to the Commissioners and has been accepted. The dimensions of the edifice will be:—Length, 500 feet ; depth, 70 feet ; height, 40 feet. Generally speaking, the structure will be built of light granite.

In taking up the electrical end of the development, the Company states that very little information is ready for publication as yet, and, therefore, my remarks, under this heading, will be necessarily limited.

In the power house there will be 11 generators, each of 12,500 horse power capacity. These machines will be very similar to the generators being built for the Canadian Niagara Power Co., and I am, therefore, showing in Plate 14 a section of one of these.

This is a copy of a drawing which appeared in the "Electrical Age" of February, 1904.

The machines are wound 25 cycle, three phase, 12,000 volt current, and having 12 poles, will revolve at a speed of 250 revolutions per minute. Some figures in connection with them are given herewith:—

Outside diameter, 18 feet 4 inches ; height, 12 feet ; diameter of revolving field, 12 feet 4 1-2 inches ; Airgap, 3-4 inch ; weight of revolving element, 141,000 pounds ; weight of complete machine, 400,000 pounds.

I have no data whatever on the exciters, but presume that these will be wound for 125 volts, and that some will be water wheel driven and some motor driven. The power house switchboard will be simple in principle, the only apparatus needed being that to control and synchronize the generators, and handle the exciters.

From the power house, underground ducts will be laid to the transformer house, about 900 feet away, where the current will be stepped up to 60,000 volts and transmitted to Toronto.

The route of the transmission line has been laid out, and a right of way with a minimum width of 80 feet has been acquired, the total distance being 75 1-2 miles.

The location of the line has been selected with a view to the utilization of the right of way lands not only for electric power transmission, but for railway purposes also, and in this respect it may be noted that the country traversed does not present serious engineering difficulties. There will be very few curves, and the sharpest will have a radius of not less than 1,600 feet.

I understand that current will be distributed in Toronto by underground cables, at a potential of 12,000, to a number of sub-stations, where, for local distribution, it will be reduced again or changed to direct current by means of rotary converters or motor-generator sets.

Little or nothing is known about the transmission line itself, except that it will follow generally the design used by the Mexican Light and Power Co., which was one of the first concerns on this continent to adopt long spans.

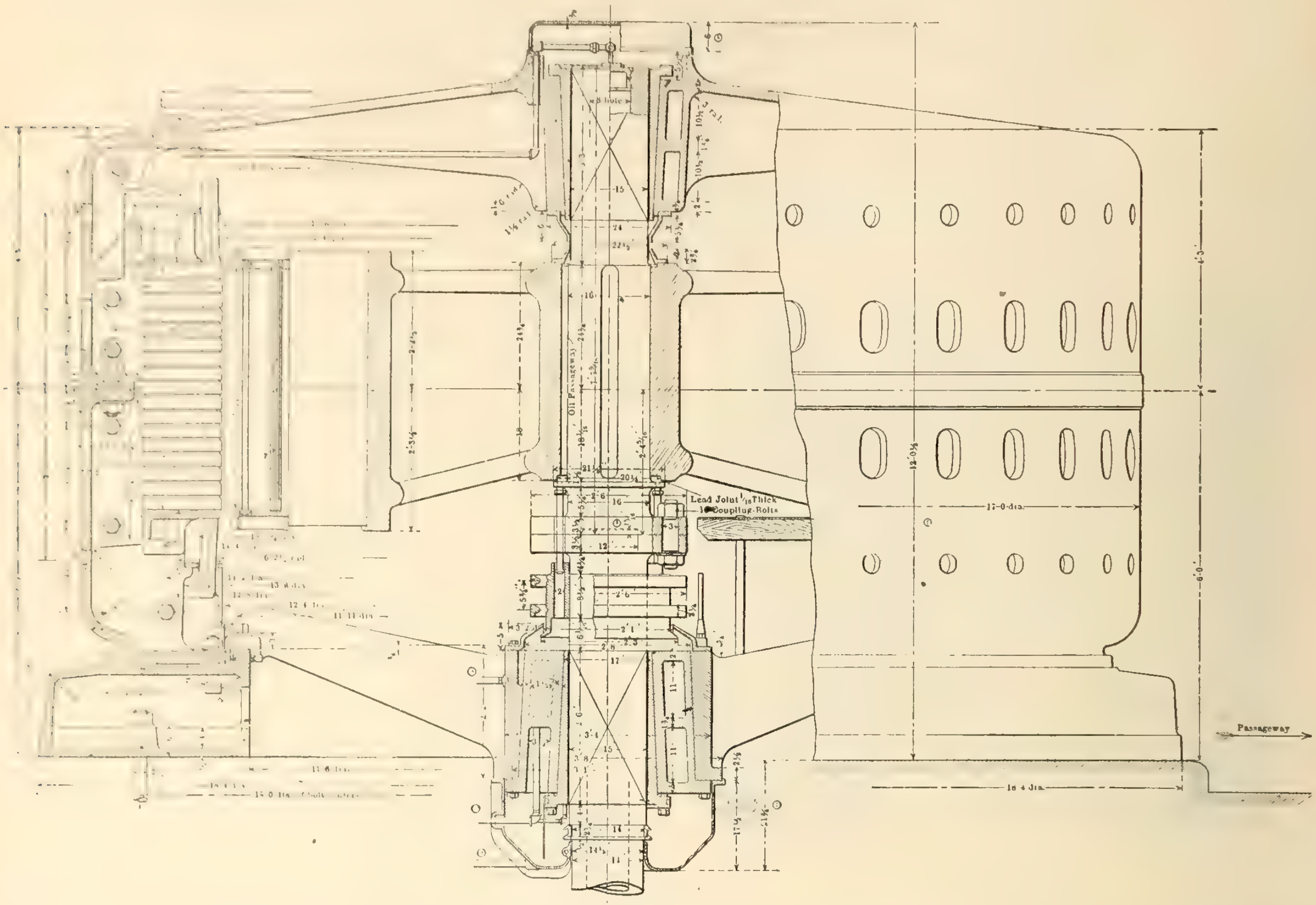


Plate 14.

In a paper read before the American Institute of Electrical Engineers, in New York, last February, the question of long vs. short spans was discussed, and the author of the paper stated that in Europe the use of the long span for high tension, long distance work was now almost universal. Wood poles have the advantage of insulation in dry weather, but while the steel pole costs a good deal more in the first place, its life is so much longer and its strength so much greater that its use is almost imperative where long spans and heavy wires or cables are used.

In the Toronto-Niagara line two rows of steel towers will be used, each pole supporting two three-phase circuits. The towers will be 50 or 60 feet high, and will set about 400 feet apart. Each cable will be made up of six No. 6 wires, stranded together around a hemp core. This construction gives a wire that is very flexible, considering its area, and also gives the form of a hollow conductor. The cables will be arranged in the shape of an equilateral triangle, a distance of from five to six feet separating the wires of each circuit. The practice in America is to set the triangles so that one side is horizontal. In almost all European lines, one side of the triangle is set perpendicular, which seems a much better arrangement, as it reduces to a minimum the danger of the wires swinging together, and this is a point requiring much consideration, in long span work. I do not know which method will be used on the Toronto-Niagara line.

A sample insulator was on view at the office of the Toronto Star, some time ago, and I secured some information on its design. This insulator is made of brown glazed porcelain and weighs about 22 pounds. The greatest width is 15 inches, and the overall height is 14 inches. The distance of surface leakage, from the tie wire to the pin is about 40 inches; the striking distance being approximately 21 inches.

The Ontario Power Co.'s transmission consists of two lines, wooden poles being used, set about 100 feet apart. The wires are not yet strung, but on one of the poles I saw two insulators in place, these being of glass.

The Electrical Development Co. has secured a property containing 530 acres, in the vicinity of the Falls, and this is to be rented or sold for manufacturing or other purposes. The land has a frontage on the Welland River of over one and one-half miles, and is located about three miles from the mouth of the river, and about two miles from the town of Niagara Falls. It is expected that this land will be taken up by manufacturers using electro-chemical processes, or other large power-using businesses.

In concluding this paper, I could spend much time in painting a brilliant future for the city of Toronto, but I think this subject is pretty well understood.

I wish to express my sincere thanks to Mr. Frederic Nicholls, Mr. H. G. Nicholls, Mr. McDougall, Mr. Brown, Mr. Value, and Mr. Hoyles, for their kindness in furnishing the information which has enabled me to put the matter in its present shape. No doubt there are very many points which have been overlooked entirely, but in a paper of this length, and with an installation of such magnitude, it is not possible to go into details.

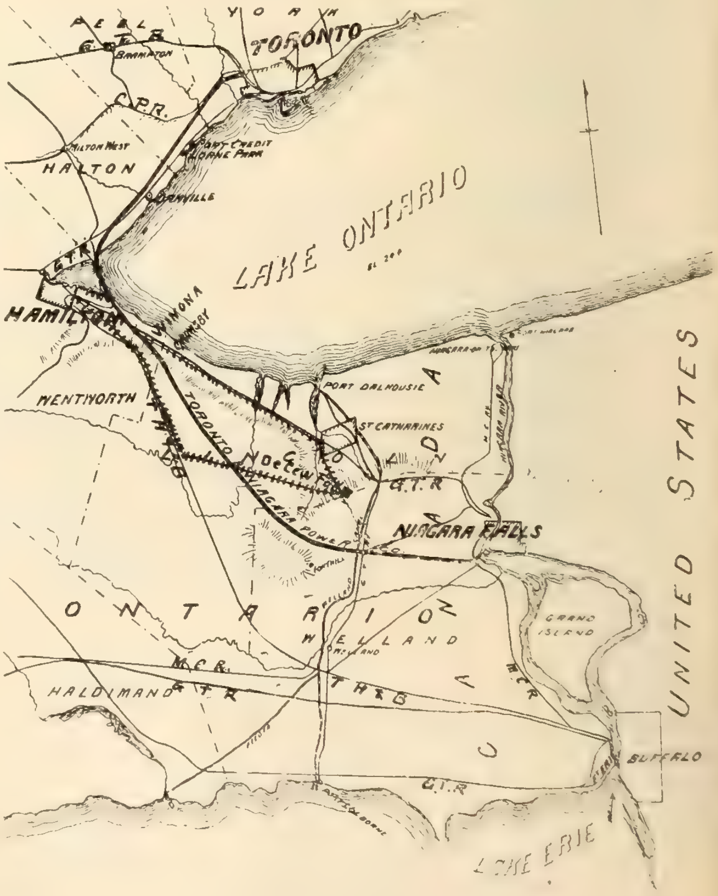


Plate 15.

June, 7th, 1904.

SOMETHING NEW IN ARC LAMPS.

The following is a description of arc lamp recently invented in England which has obtained great success amongst engineers. We think its various features will be of interest to our readers:

The lamp is of Mr. C. E. Foster's patent hot wire design, Mr. Foster has been grappling with this question since August 1901. It is true that others have got as far as the patent office even before Mr. Foster but they no doubt discovered that, although the idea was comparatively easy of conception it was a very difficult matter to put into practical form. After considerable research, nine-tenths of the difficulties hitherto inseparable from the solenoid control arc lamp have been overcome and the solenoid altogether abolished. The Foster lamp is not perfection nor infallible, but it is claimed to have fewer weak points and more chances of long life than is possible with the solenoid lamp.

The friction of the carbon sheath in the tube and of the carbon at the chimney brush is negligible as also at the trunnions of the levers and the link, whose duty is to transmit the difference between the forces in the spring and strip respectively to the clutch, for the raising and and holding in right position the top carbon. The difference, which is of course in favor of the spring, is so little in excess of the weightof the carbon and the sheath that the strain of the strip when hot is but a few ounces. The strip will stand without permanent elongation at least ten times the strain that the spring can possibly produce on it and will carry about three times the striking current without deterioration.

Everything throughout the lamp is fire-proof in the ordinary sense and the current is carried by flexible copper connections to the carbons. There is no possibility of sparking at any rubbing surfaces. The lamp is readily accessible for cleaning purposes and a new strip, or any other parts, may be replaced with facility—in no case requiring the lamp to be taken down.

The machanism proper or the Foster arc lamp weighs but 8½ oz., and there is ample margin of safety even in these figures. The strip is the soul of the lamp, it being responsible for the control of the striking and feeding mechanism. A strip which had been in a lamp used for outside lighting for over two years was lately examined. It was. of course, very dirty but not rusty; no stretch was perceptible and its action was as prompt as when installed. It was tested up to 30 lbs. and broke at 46 lbs. It exhibited toughness and the elongation before fracture was 15 per cent. It may reasonably be expected that the life of a strip will be at least five years. Should a strip fail a new one can be hooked on and connected by hooks at each end in five minutes or less, and the dirty parts removed, cleaned and replaced in another five minutes—all this without removing the lamp, at a cost of a few cents. One cannot help contrasting this with the burnt-up solenoid lamp, which must go back to the repair shop for a month or so and wait its turn to be renovated—and then at a cost of from $5 to $9.

The design of the lamp has been scientifically laid out, thus allowing the lamp to be operated in any temperature. It is unaffected by any atmospheric variation and can be run practically under any condition without affecting its satisfactory burning. It is symmetrical in design and graceful in appearance. The whole of the mechanism is protected by perfectly weather-proof case, making the lamp suitable for indoor or outdoor working. The internal parts are all interchangeable and are constructed and protected from any deteriorating element.

It is almost self-suggestive that the avoidance of coils and dash-pot would bring with it additional advantages, and such is really the case. Mr. Foster finds that very little more than the internal resistance of the lamp and mechanism—about 2 ohms—is needed on direct current. Mr. Foster deals with high voltage circuits in connecting three lamps in series, and he finds that, in a case of 240 volts, no resistance other than that of the thermo-expansive strip is necessary. The current was 5.5 amps. and the volts across the carbon points totalled 216, or 72 volts per lamp. Solid carbons were used and there was no unsteadiness. This amounts practically to getting 50 per cent. more light for the same consumption of power as compared with the usual method. Similar results were obtained on a London, Eng., circuit of 230 volts continuous. On 100 to 200 and 220 volt circuits, the saving is from 10°/₀ to 25°/₀.

But it is on alternating current circuits that the lamps appear to the best advantage. An a.c. lamp being adjusted to work off a transformer the current is 2.25 amps. at 220 volts, periodicity 50, consumption 495 watts, total losses in transformer, choking coil and so forth 58 watts. The transformer is of a three-way compensator design. This will manipulate two other similar lamps and when the three lamps are switched on they are burning in series, each of the three sections of the transformer being a shunt across one lamp in the usual way. The power factor of the lamp itself is unity and the choking coil absorbs very little power. Foster lamps will burn with non-inductive resistance in circuit but the efficiency, though good, is not as high as is obtainable by the introduction of inductance. It is. however, anticipated that it will shortly be possible to abolish the choking coil, when the power factor of the whole circuit will be practically unity on an alternating current circuit.

As these lamps work three in series on 220 volt a.c., it is to be presumed that they will work equally well on circuits of higher vo'tage. Perhaps the most remarkable characteristic in this lamp is its apparent indifference to circuit conditions, as will be shown by the following experiment. A lamp adjusted to burn on 110 volt continuous circuit and connected also by a double pole throw over switch to a 110 volt alternating circuit, periodicity 60. This lamp is switched over from a continuous current circuit to an a.c. circuit without the arc breaking. Of course there is the usual difference in the light, however, but at first it is difficult to realize that any change has actually taken place.

The makers guarantee an increase of 10 to 30 per cent. effectual watts at the carbon points over any other magnetically controlled arc lamp. Consider what this will save the lighting company or the consumer. The higher the circuit voltage the higher the efficiency, but the opposite has always been the case with other makes of lamps. The Foster also has the advantage in weight, only scaling 12½ lbs. complete. Its over-all length is 28 inches and it is adaptable for every commercial use. The current consumption of the lamp has a big range of adjustment and we understand that the makers can give a variation from five to fifteen amperes.

The Canadian Foster Arc Lamps Company, of 41 Janes Building, Toronto, are handling these lamps, also the special flame carbon for advertising purposes. In the event of any of our readers being interested, the above company will be pleased to render any assistance on points that may not be clearly defined or mentioned in the above description.

MOONLIGHT SCHEDULE FOR SEPTEMBER.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Sep. 1	7 00	Sep. 1	11 45	4 45
2	7 00	3	0 30	5 30
3	7 00	4	1 10	6 10
4	7 00	5	2 10	7 10
5	6 50	6	3 10	8 20
6	6 50	7	4 15	9 25
7	6 50	8	4 45	9 55
8	6 50	9	4 45	9 55
9	6 50	10	4 45	9 55
10	6 50	11	4 45	9 55
11	6 40	12	4 45	10 05
12	6 40	13	4 45	10 05
13	6 40	14	5 00	10 20
14	6 40	15	5 00	10 20
15	6 40	16	5 00	10 20
16	6 30	17	5 00	10 30
17	10 30	18	5 00	6 30
18	11 30	19	5 00	5 30
20	0 20	20	5 00	4 40
21	1 20	21	5 00	3 40
22	2 15	22	5 00	2 45
23	3 10	23	5 10	2 00
24	No Light	24	No Light	
25	"	25	"	
26	6 20	26	8 30	2 10
27	6 15	27	9 00	2 45
28	6 15	28	9 40	3 25
29	6 15	29	10 20	4 05
30	6 15	30	11 10	4 55
		Total	.. .	185 05

CORRECTION.

Our attention has been called to a mis-statement made in a paragraph under the heading of "Sparks" printed on page 12 of our July issue, in which it was stated that Mr. A. R. McDonald had made a recent purchase which gave him the control of all the water powers in the Quebec District. This is entirely incorrect, as Mr. McDonald does not control the power at Montmorency, Jacques Cartier or Chaudiere River.

LIST OF BRITISH FIRMS WANTING CANADIAN AGENTS.

Brooker & Goss, Ltd., mfrs. Electrical Instruments, Broad St. House, London, E.C.

The Electrical & Ordinance Accessories Co.,-Ltd., Birmingham, Electrical Supplies.

Rhodes Electrical Mfg. Co., Ltd., 70 Bishopsgate St., London, E.C.

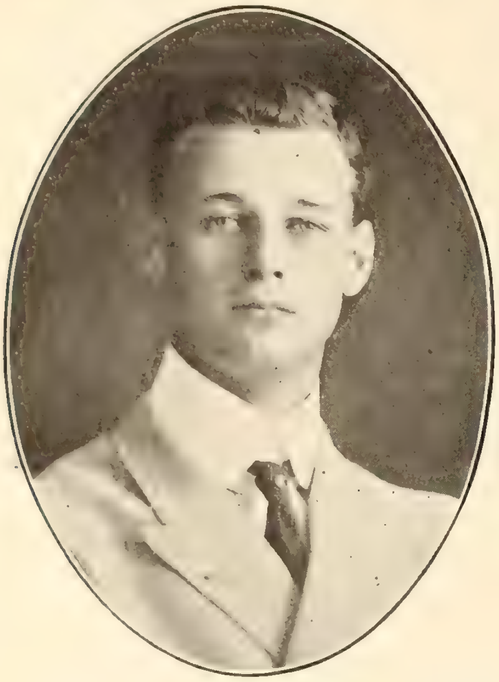
W. F. Dixon & Co., Manchester, Mfrs. Raw Hide Silent Gears.

Veritys Limited, King St., London, W. C., Electrical Supplies.

Johnson & Phillips, Union Court, London, E.C., Electrical Instruments, Lamps and Supplies.

Nalder Bros. & Thompson, Ltd., Queen Street, London, E.C., Electrical Instruments.

Improved Electric Glow Lamp Co., 7, Great Newport Street, St. Martin's Lane, London, W.C., mfrs. of Street Lighting Apparatus and Electrical Supplies, including Arc and Incandescent Lamps.



MR. K. L. AITKEN,
Chief Engineer The Electrical Supervision Society, Toronto.
[Mr. Aitken's article on the Niagara Power Development appears on page 162 of this issue.]

Everett, Edgcumbe & Co., 151 and 152 Great Saffron Hill, Holborn Circus, London, E.C., manufacturers of Electrical Measuring Instruments of every description.

Davis Electric Lamp Co., 17, Moor Street, Cambridge Circus, W. London, Eng., manufacturers of Electric Specialties and Supplies, including Switches, Switchboards, Insulated Tubes, etc.

Northern Electric Wire Co., Sedburgh Mills, Halifax, Eng., makers of all descriptions of Vulcanized Flexible Cords, Electric Light Wires and Cables.

Zurich Incandescence Lamp Co., 47, Victoria Street, Westminster, London, S.W., manufacturers of British Incandescent Electric Lamps.

Foxcroft & Duncan, Queen's Road, Dalston, London, N. E., manufacturers of a full line of Electrical Recording Instruments, Carbons, Globes, Telephones, etc.

W. Clark Fisher, patentee and manufacturer, specialist in Electrical Measuring Instruments of Precision, Potentiometers, etc.

The London Electrical Fittings Co. Limited, Hampstead Road, London N. W., manufacturers of Artistic Electric Light Fittings and accessories.

Johnson & Phillips, Old Charlton, Kent, Eng., mfrs. of Electrical Plant for power lighting or Traction.

The Reason Manufacturing Co., Limited, Lewes Road, Brighton, Eng., mfrs. of Electroylytic Meters.

Canadian firms in a position to handle successfully the goods of any of the above British exporters should communicate with them direct, mentioning the CANADIAN ELECTRICAL NEWS.

Mr. T. O. Crandall, superintendent of waterworks and electric light, Picton, Ont., was a delegate to the annual encampment of the I.O.O.F. held in Toronto last week.

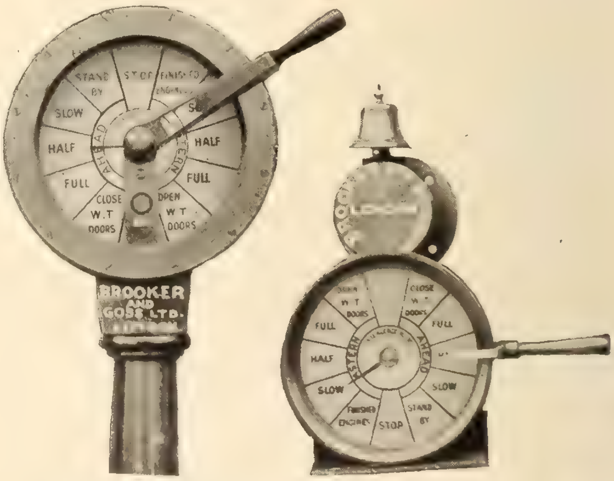
THE ALCOCK ELECTRIC SHIPS TELEGRAPH.

An invention which is creating considerable interest in shipping circles, and likely to be used very extensively by steamship owners, is the Alcock Patent Electric Ships Telegraph. This system takes the place of that in vogue at present, and while the signals from the bridge to the engine room are sent as before by simply moving a lever to the point required, the work is done by a simple electrical mechanism, and the action of the engineer in the engine room is registered immediately on the bridge by means of an apparatus attached to the propeller shafting, thus indicating whether the speed of the engines has been increased or decreased in accordance with the navigating officer's signal. This is of considerable importance, as many accidents have taken place through either the instructions not being sent along correctly, or through carelessness in carrying out the orders from bridge.

To send the signal to the engine room the handle of the bridge instrument is moved to the required order, which will cause the needle on the engine room instrument to indicate the corresponding order, and at the same time sets the bell ringing, and it will continue to ring until the lever of the engine room instrument is moved to correspond with its needle, and this has the effect of setting the needle on the bridge instrument to correspond, thus indicating that the order has been correctly received. If the order has been wrongly carried out, the needle on the bridge instrument will show what has been done, and the mistake in the engine room may be at once corrected.

The bell on the bridge instrument is set ringing at the same time that the order is signalled at the engine room, and only stops when the reply signal comes from the engine room. The fact of the bell having stopped ringing is no indication that the message has been correctly received, as the engine room lever might be placed to any other order, and still stop the bell ; continuous ringing is simply to enforce the engineer to reply at once, but the needle on the dial of the bridge instrument tells what has been done. In practice the engine room instrument is fixed on the engine staunchion in proximity with the starting gear, so that it is very convenient for the engineer to work, and those engineers who have tested the instrument at sea are all of opinion that it has a great advantage over the mechanical system, as often in practice the signalling is much more rapid, and consequently enables them to follow the captain's orders to a much better advantage.

The battery power required to work the instrument effectively should be say a 9 cell accumulator, 20-30 ampere hours capacity, having a discharge rate of 2-3 amperes. The battery should go 18 volts approximately when newly charged, which will fall to 16 volts when it will require a fresh charge. The instruments will work on as low as 10 volts, but it is always better to leave a margin, and should be worked well over this.



Several steamers have been recently fitted up with this apparatus, and the machines have shown to such advantage, that it is likely the Alcock system will be installed on most of the steamers in the United Kingdom. The manufacturers of these instruments are Brooker & Goss, Limited, London, Eng.

Business men of Moosomin and Arcola, N.W.T., are considering a proposition to construct an electric railway to connect the C. P. R. main line with the Estevan and Soo lines to the south. The installation of telephone systems is a part of the project.

SPARKS.

The Grand Trunk Railway Company have installed a new generator for lighting their yards and plant at Windsor, Ont.

A storage battery plant has been installed in connection with the electric railway at Port Arthur, Ont., which is operated by the corporation.

The Canadian Westinghouse Company have been awarded a contract for the supply of electrical apparatus required by the city of Winnipeg.

The electors of Thamesville, Ont., have approved of a by-law to raise the sum of $6,000 for the purchase of the electric light plant now owned by a private company.

It is expected that as soon as the lighting plant of Kingston, Ont., is municipalized, the citizens will be asked to vote about $100,000 to increase and remodel the plant.

The Ford Motor Company is being formed at Walkerville, Ont. to manufacture automobiles. The promoter is Mr. Gordon McGregor and the proposed capital stock $125,000.

The Light Committee of the Town Council of Strathcona, N.W.T., have reported adversely on the proposition of the town of Edmonton to supply power for the electric plant at Strathcona.

Engineer Hamel has reported to the Hull Town Council that it will cost $37,000 to develop the water power which the town recently acquired. The power is required for water-works and lighting purpose.

The Hamilton Radial and Electric Railway Company, of which Mr. William C. Hawkins is general manager, have commenced the construction of an electric railway from Burlington to the town of Oakville, a distance of ten and one-half miles.

The Bell Telephone Company's franchise in the city of Kingston, Ont., expired a short time ago and has not yet been renewed. Under a new offer the company agrees to erect a modern exchange, and it is probable that the proposition will be accepted.

Mr. J. W. Baker has been appointed manager of C. P. R. Telegraphs at Winnipeg, succeeding Mr. John Tait, recently promoted to the position of assistant to General Superintendent Jenkins. Mr. Baker has been in the service for some years, latterly as wire superintendent, and, possesses wide expert knowledge.

Incorporation has been obtained by the Hawkesbury Electric Light & Power Company, Limited, with a capital stock of $100,000 and head quarters at Hawkesbury, Ont. The purpose of the company is to acquire water power and to develop electricity. The incorporators are Thomas Ross, James Ross, John W. Ross, Marry Ross and Georgina Waddel.

The Chicago Telephone Supply Company have offered to install a complete telephone system in the city of Brantford, Ont., for $37,500, the system to include five hundred phones, with an ultimate capacity of one thousand, and the entire plant to be of the best construction, including an underground system in the business portion of the city. It is understood that there is strong feeling in favor of accepting the proposition.

The additions and improvements to the St. John Street Railway Company's plant which have been under way for some time are now practically completed. The Laurie Engine Company, of Montreal, installed a horizontal cross compound automatic condensing Corliss engine capable of producing 1,500 horse power, and the Canadian General Electric Company installed a 650 kilowatt direct-connected generator. The old plant has been retained as an auxiliary.

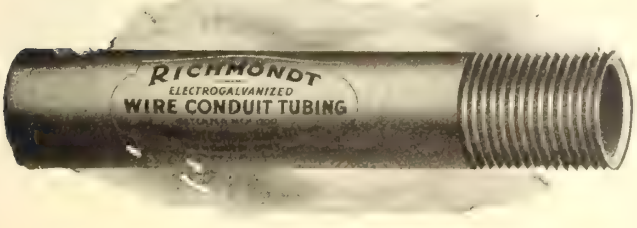
ELECTRICAL REPAIRS

In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

MESSRS. FRED. THOMSON & CO.
774 Craig Street, MONTREAL, P.Q.

have arranged their works for repair work only. They keep armatures of nearly all makes of dynamos in stock, which they loan while repairs are being made. The factory is so arranged that they can run night and day, and work can be finished in the shortest possible time. Telephone Main 3149.

The RICHMONDT CONDUIT & MFG. CO., Limited
Sole Manufacturers of
Richmondt Electro-Galvanized and Navalite Conduit Tubing and Fittings
For Absolute Safety in Interior Wiring.



Factory and Office : 15, 17 and 19 Jarvis St., Toronto, Canada

Clarkson School of Technology Thos. S. Clarkson Memorial
Potsdam, N. Y.

Courses leading to degrees of Bachelor of Science in Chemical, Civil, Eectrical and Mechanical Engineering, comprising four years of thorough training and resident college work in theory and practise of engineering. Well equipped shops, laboratories, drafting rooms and power plant. Located near Massena and the engineering developments along the St. Lawrence River. Healthful climate. Tuition and living expenses moderate.

WM. S. ALDRICH, Director

NEW TELEPHONE LINE

A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates :

Port Rowan - 50c.
St. Williams - - 50c.
Vittoria - - 40c.

THE BELL TELEPHONE CO. OF CANADA

American Circular Loom Company's
AMERICAN CIRCULAR LOOM CO.
TRADE MARK
REGISTERED
FLEXIBLE CONDUIT

MONTREAL ELECTRIC COMPANY, AGENTS.

The ORIGINAL and only GENUINE "Circular Loom." Has been in the market for twelve years, and handled by us for over nine years. No other substitute has ever taken its place for quality and adaptability. For price lists, discounts and full information, address

Montreal Electric Company, 354 St. James Street, Montreal
Instant shipment made. Large stock of all sizes always on hand.

SPARKS.

The Town Council of Almonte, Ont., have decided to make important improvement to the electric light plant.

The Board of Control of the city of Toronto are asking for tenders for the privilege of installing and operating a telephone system within the city limits. Tenders are to be submitted by October 1.

The Robb Engineering Company, of Amherst, N.S., have secured the contract to supply two Robb-Mumford boilers of 125 h. p. each and one tandem compound condensing engine of 150 h. p., with condenser and feed water heater, for the electric light and waterworks plant now under construction at Moose Jaw, N. W. T.

The Grand Falls Water Power Company have paid into the New Brunswick treasury $10,000 on account of the deposit required from the company by the Government as a guarantee that the proposed development of the water power at Grand Falls, N.B., will be proceeded with. The establishment of works by the Electric Manganese Company at Grand Falls is to follow.

The ratepayers of Preston, Ont., have voted in favor of municipal ownership of the electric lighting plants. The Council have been authorized to raise $8,500 to purchase the existing incandescent plant owned by Mr. Shearer and the arc plant owned by Mp. Fenwick. Both plants will be moved to a central power honse to be built this fall and thoroughly modernized.

The Grand Valley Company have decided to erect a new power house for their radial electric railway running from Galt to St. George, Ont. The site chosen is on the line between Paris and Blue Lake about two miles from Preston. The building, for which P. D. Secord & Company have secured the contract, will be 71 x 47 feet.

Electric power consumers in Orillia, Ont., are again obtaining a supply of current, after being shut off for three months, owing to the breaking of the power dam. The power now supplied is generated with steam by an auxiliary plant at the pumping station and gixes a ten hour service of 350 horse power. At night the plant is operated for lighting only. Owing to additional expense in generating electricity by steam, the Council have raised the price for lighting from twenty cents to twenty-five cents net per 16 c. p. lamp for residences. The price of power has been almost doubled.

Mr. James Kemp, general manager of C.P.R. Telegraphs, states that the company will construct two thousand miles of new wire this year. In the eastern division the lines are being reconstructed all the way from Lake Superior to Quebec. In the west a large amount of new line has been built. Between Laggan aud Lake Superior alone, in order to meet the development in that district, over six hundred miles have been built since the first of the year, and a new copper wire has been strung between Winnipeg and Regina. Among the new lines in British Columbia is one sixty-five miles in length from Vernon to Kelowna.

WANTED—10 or 15 4 Amp. series Arc Lamps new or second hand. R. C. McLeay, Watford, Ont.

THE ROSSENDALE BELTING COMPANY
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OF MANCHESTER, ENGLAND.

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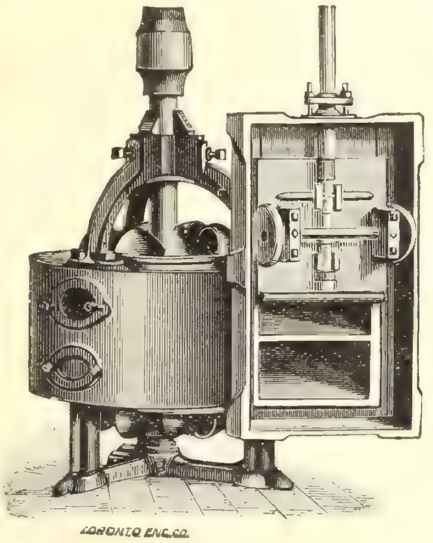

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The Bathurst Light & Power Company propose to develop a water power on the Tatagouche river near Bathurst, N.B., for the production of electricity. J. P. Lagere and P. J. Venot are interested in the company.

Mr. Frederic Nicholls, general manager of the Canadian General Electric Company, and Messrs. E. R. Wood and D. E. Thomson, K C., are reported to have secured a controlling interest in the Niagara Fa'ls Gas & Electric Light Company, which owns valuable franchises for gas and electric lighting in Niagara Falls, N.Y., and other municipalities along the east side of the river to LaSalle, near Buffalo. The company has been reorganized with Mr. Nicholls as vice-president and treasurer and Messrs. Wood and Thomson on the board of directors. It is their intention to fully exploit these franchises, although it is not yet announced whether it is the intention to develop power or to obtain their current supply from the existing plants.

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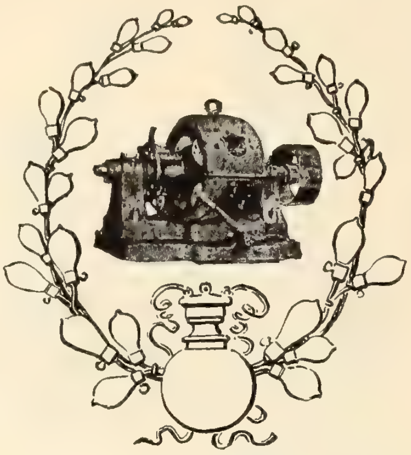

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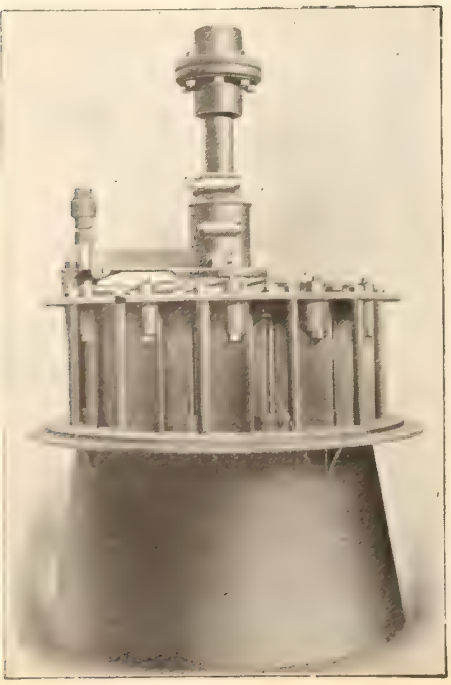

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The New Brunswick Telephone Company are building a new exchange at St. Stephen, N.B.

The Bath Consolidated Telephone Company, Bath, N.B., are extending their line by the construction of forty miles of new wire from Kilfoyle Settlement to the border of Northumberland County.

Some of the vast amount of latent power in the vicinity of Winnipeg, Man., is to be utilized, for which purpose the Manitoba Water Power Electrical Company has been organized, with a capital of $5,000,000. The officers of the company are: President, Hon. H. J. Macdonald; vice-present, Sir Daniel McMillan, Lieut-Governor of Manitoba; secretary-treasurer, R. P. Roblin, Premier of Manitoba. The proposed point of development is Silver Falls, one of the best cascades on on the Winnipeg river. The company expect to be in a position to deliver power in Winnipeg within eighteen months.

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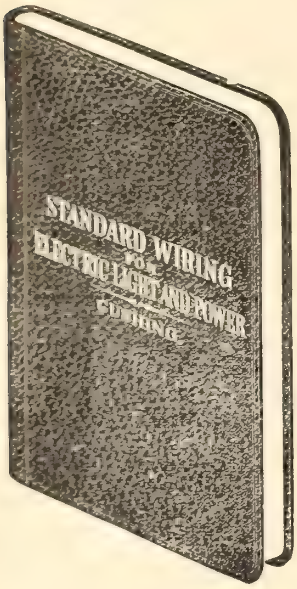

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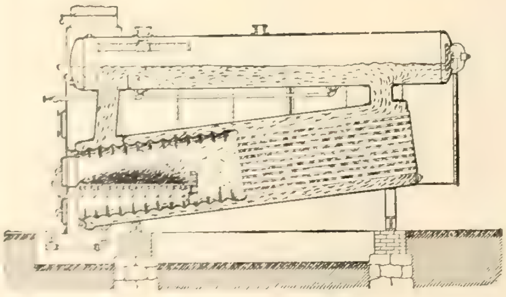

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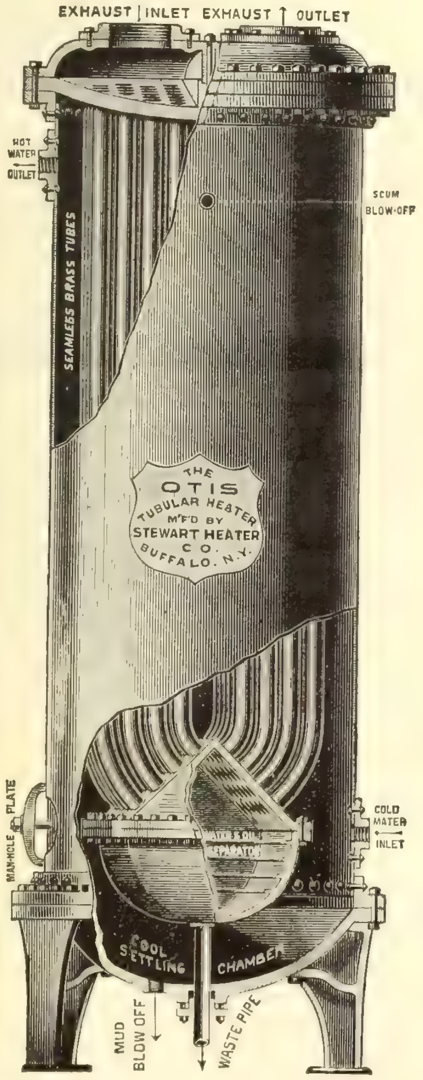

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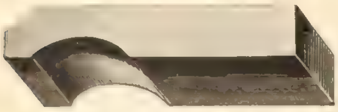

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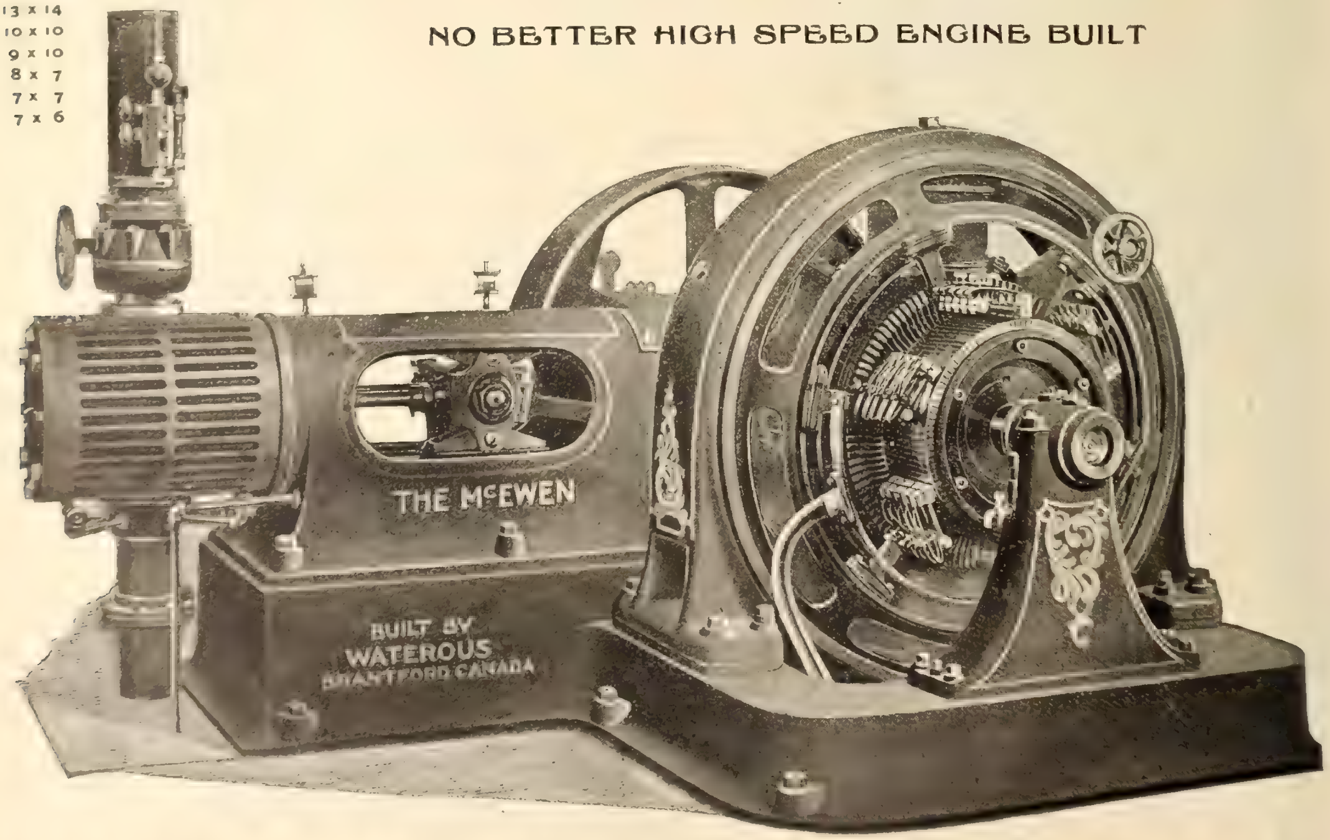

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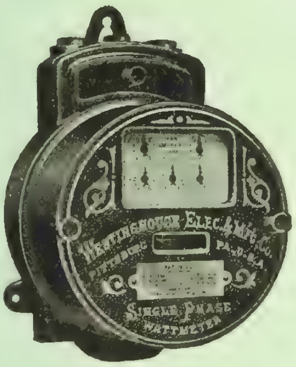

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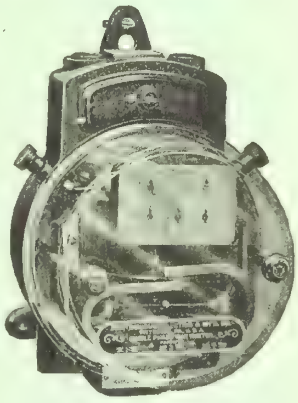

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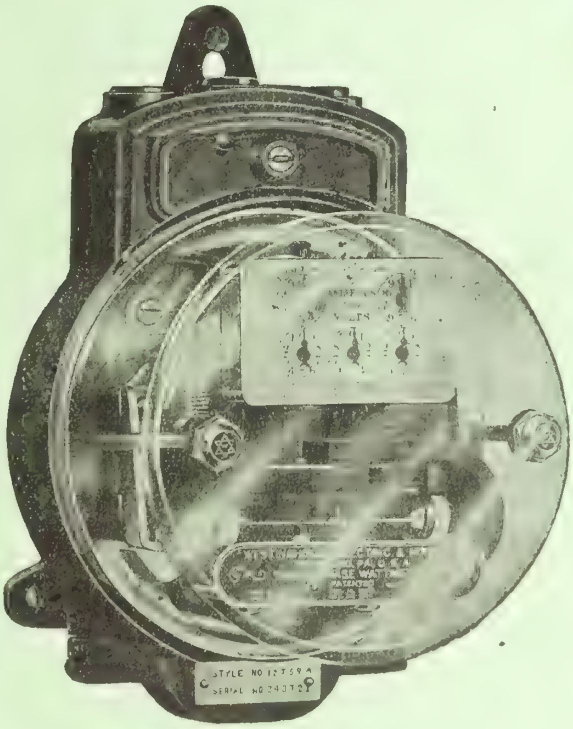

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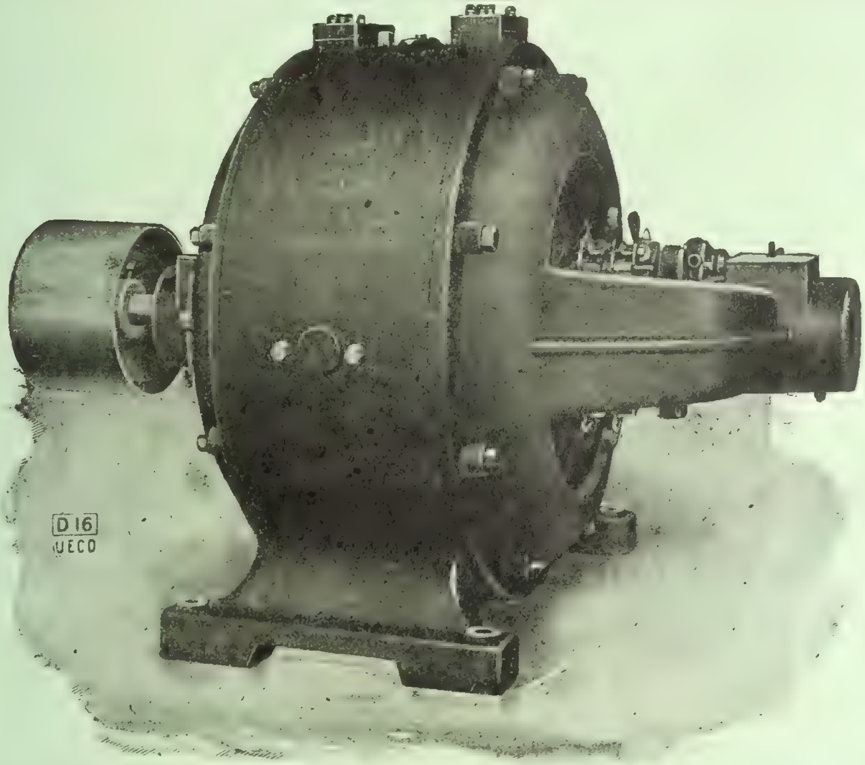

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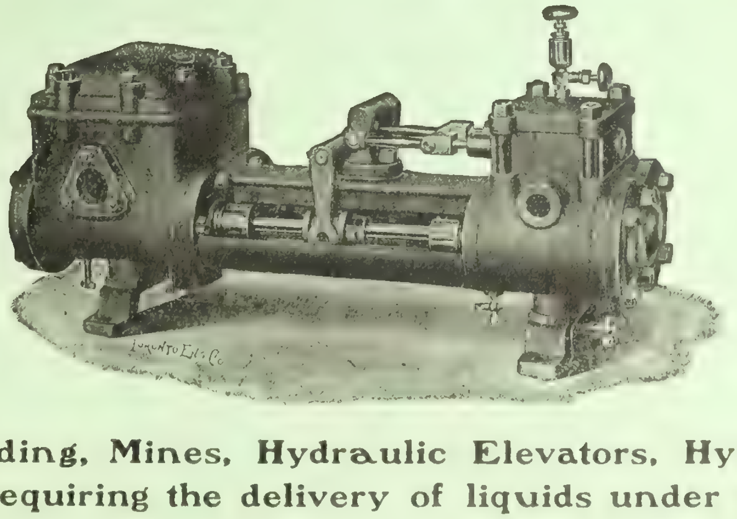

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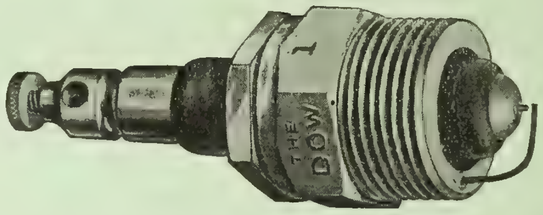

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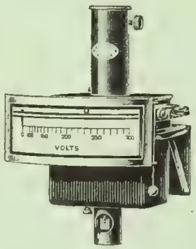

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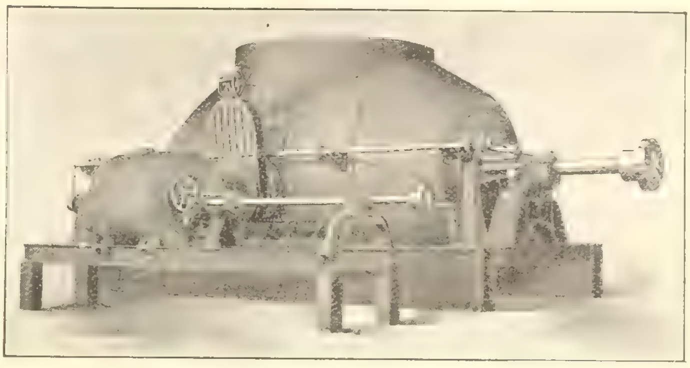

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Write for catalogue if contemplating purchase of Turbines.

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SPARKS.

It is stated that the Quebec Electric Company, of Quebec, intend building an electric railway from St. Anne to Murray Bay.

The new sub-station at New Westminster for the British Columbia Electric Railway Company has been completed and the installation of the machinery is now under way.

The car shops of the British Columbia Electric Railway Company at New Westminster, B.C., were totally destroyed by fire about the middle of August, entailing a loss of $25,000. The work of rebuilding was commenced immediately.

Poles are being erected and other preparations made for lighting the villages of St. Andrews and Carillon, Que., with electric light. The power is obtained from the North river at Isle au Chats and the work is being carried out by the Selby Company, of Montreal.

Mr. R. E. Kinsey intends to develop a water power on Lamb Creek and install an electric plant for lighting the village of Moyie, B.C., about two miles distant. The surplus power will be used for mining purposes. The plant will cost about $18,000, and it is the intention to have it in operation by January next.

Wood-Working Machinery

The line of wood-working machines made by The Goldie & McCulloch Co., Limited, Galt, Ont., is in great demand. They build an extensive range suitable for almost any kind of wood-working etablishments. Their machines are built very heavy and made to stand hard and continuous work. Send for a catalog. Address

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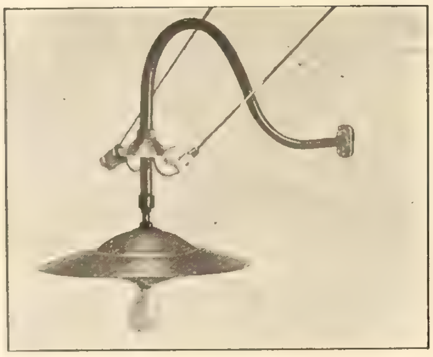

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We manufacture a complete line and would be pleased to quote on your requirements. . . .

SWITCHBOARDS AND PANELS

THE R. E. T. PRINGLE CO., LIMITED

Manufacturers and Dealers in

Electrical Apparatus and Supplies

ST. JOHN MONTREAL TORONTO

SPARKS.

W. S. Hearn, electrical supplies, Winnipeg, Man., has old his business to Charles Goodyear.

Messrs. Prowse Bros. & Crowell, of Sydney, N.S., intend installing an electric plant for lighting their store premises.

The Sayer Electric Company, Montreal, has been dissolved, and Mr. E. W. Sayer will conduct a business under the same name.

The Council of Niagara Falls, Ont., propose to issue bonds to the extent of $15,000 for the purpose of extending and improving the electric light plant.

The City Council of St. John, N.B., have decided to purchase the electric light plant of the Carleton Electric Light Company, at the price of $25,000.

The John McDougall Caledonian Iron Works Company, of Montreal, will supply that city with three boilers for waterworks purposes. Their tender was $15,350.

Stephens & Hawkins, of Victoria, B.C., are installing the electrical machinery in connection with the new carpenter shop for the Imperial Government at Esquimalt.

The Secretary of the Board of Trade of Sydney, N.S., has been instructed to ascertain the probable cost of an electric or gas lighting plant to be installed by the town.

Mr. John Fachine, night engineer in the electric light works, Regina, N.W.T., was on August 18 found in an unconscious condition with a gash in his head. It is supposed that he was struck with the crosshead of the engine.

An order has been made by the Prethonotary of the district of Arthabaska declaring the Plessisville Electric Company, of Plessisville, Que., insolvent. Mr. J. B. Dupuis, of Plessisville, has been appointed provisional liquidator.

Mr. Kelly, of Goderich, was engaged by the council of Seaforth, Ont., to value the electric light plant. His estimate was placed at $19,300. The company have agreed to accept this figure, and a by-law authorizing the purchase of the plant will be submitted to a vote of the ratepayers on September 12th.

United States Steel Products Export Co.
Battery Park Building, NEW YORK

Rails and Special Work for Electrical Railways
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With Hollow or Solid Terminals—Applied With Steel Drift Pin or Screw Compressor.
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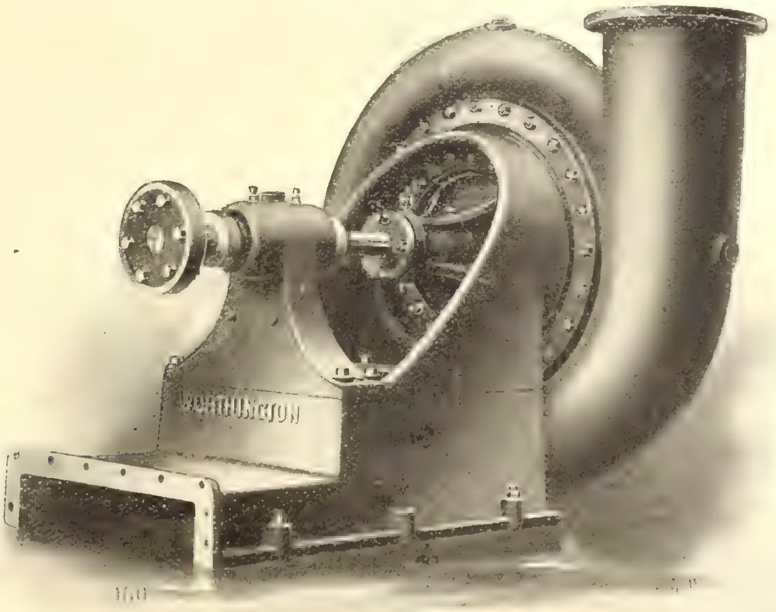

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Eighteen Inch WORTHINGTON VOLUTE PUMP
Designed for direct connection to a steam engine and used for supplying water to elevated jet condensers in the Power House of the Manhattan Elevated Railway Co., New York City.
Capacity, 10,000 gallons per minute against 25 feet head.
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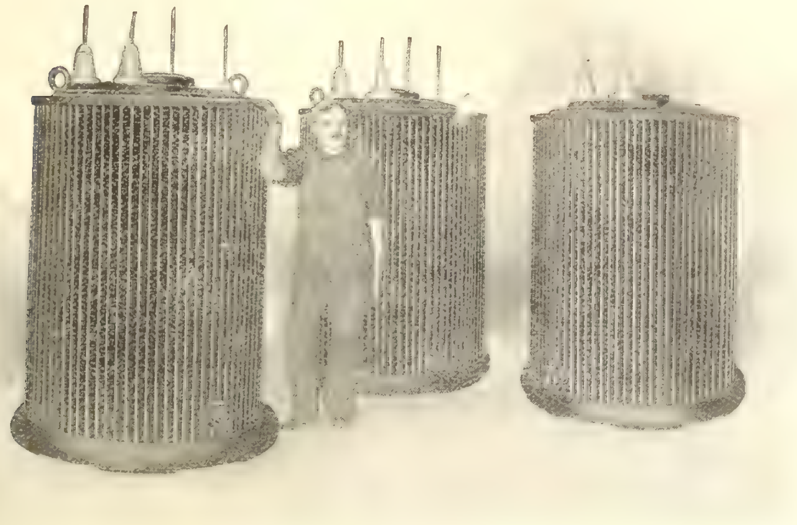
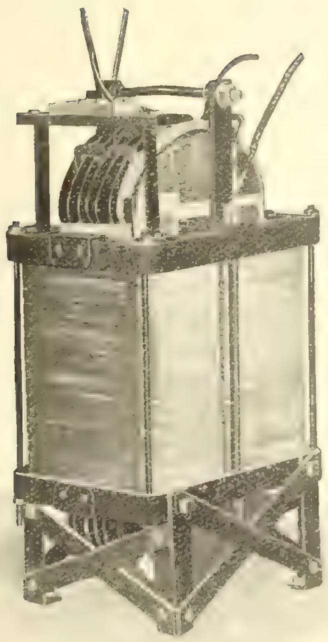
C. W. BONGARD & CO.,
52 Adelaide St. West,
Toronto, Canada

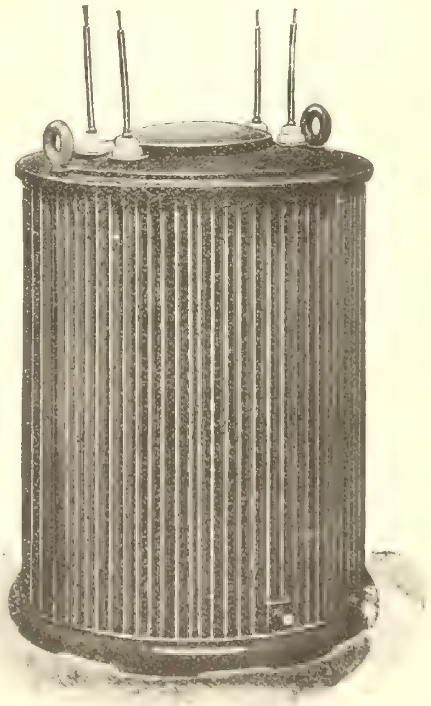


Pittsburgh Transformers.

Three 150 Kilowatts, 11,000 Volts, 60 Cycles,
Self-Cooling, Oil Insulated.



These high voltage power transformers are characterized by low temperature rise and the entire absence of hot spots in their coils or cores. This is secured by means of oil ducts between each pair of coils and between the coils and iron The vertical position of the windings insures a plentiful supply of cool oil flowing upwards through the several passages



Pittsburgh Transformer Company,
Pittsbugh, Pa.

Pittsburgh, Pa.
September, 1904.

SPARKS.

The Frontenac Cereal Company, Kingston, Ont., are building an addition to their power house.

The Renfrew Milling Company are building a new dam at Renfrew Ont., of cement foundation ad timber superstructure.

Surveyors have laid out the route of the proposed Ontario Traction Company's railway from Walkerville to Tecumseh, Ont.

Dennis & Company, of Minot, D.B., have secured the contract to build a new power house for the municipality of Moose Jaw, N.W.T.

The power house of the Hamilton, Grimsby and Beamsville Railway at Beamsville, Ont., was destroyed by fire on August 14th during an electrical storm.

The annual picnic of the employees of the Montreal Street Railway Company was held at Riverside Park on August 18th and 19th. It is estimated that fully 4,000 persons were present.

The City of Winnipeg have just added another generator to the electric plant, increasing the lighting capacity by 450 arc lights. It was supplied by the Canadian General Electric Company.

The British Columbia Electric Railway Company are equipping several of their cars with air brakes furnished by the Canadian General Electric Compa y, agents in Canada for the Christensen Engineering Company, of Milwaukee, Wis.

Mr. R. S. Kelsch is announced to have concluded a contract whereby the Montreal Light, Heat & Power Company will supply the Montreal Street Railway with 7,000 horse power per year at $25 per horse power for a number of years.

The first annual report of the lighting and power system of the City of Guelph, Ont., under municipal ownership, is claimed to show a profit of $10,000, after providing for maintenance, depreciation and interest on debentures.

The Southern Light & Power Company, Limited, has obtained an Ontario charter. The capital is $300,000 and the head office is in Toronto, the provisional directors including Mr. D. A. Dixon, electrical engineer, and Prof. F. J. Davidson.

The Dartmouth Electric Light Company, Dattmouth, N. S., has been reorganized, with the following board of directors: President, James Simonds; vice-president and managing director, John White; secretary, J. H. Austen; J. C. Mackintosh and Hon. S.H. Holmes. Additions are being made to the plant.

Mr. Albert H. Kirkpatrick, son of Mr. William Kirkpatrick, of Hamilton, Ont., was killed recently at Prince Albert, N.W.T., while engaged in the installation of new engines in the electric light plant there. He was superintendent of construction for E. Leonard & Sons of London, Ont., and was in his twenty-eighth year.

Electric lighting is just now a live question at Wiarton, Ont. About one year ago the Canada Furniture Company advanced their rates, since which time there has been a steady decline in the number of commercial lights used. Mr. Thede, who owns a water power at the Sauble, is anxious to secure a franchise from the town, and there is a feeling in favor of giving him encouragement to develop his power. On the other hand, Messrs. Kastner, Crawford, and Eli desire to buy the existing plant and assume the mortgage which the town holds against it. They want a twenty years' lease of the old pumping house and a ten years' contract with the town. They would build a new power house and give an all night service for what the town now pays for a midnight service, and would supply commercial lights below the present rate.

ELECTRICAL REPAIRS

In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

MESSRS. FRED. THOMSON & CO.
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have arranged their works for repair work only. They keep armatures of nearly all makes of dynamos in stock, which they loan while repairs are being made. The factory is so arranged that they can run night and day, and work can be finished in the shortest possible time. Telephone Main 3149.

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Courses leading to degrees of Bachelor of Science in Chemical, Civil, Eectrical and Mechanical Engineering, comprising four years of thorough training and resident college work in theory and practise of engineering. Well equipped shops, laboratories, drafting rooms and power plant. Located near Massena and the engineering developments along the St. Lawrence River. Healthful climate. Tuition and living expenses moderate.

WM. S. ALDRICH, Director

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A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates:

Port Rowan	50c.
St. Williams	50c.
Vittoria	40c.

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The Largest Central Stations make no mistakes when buying Lamps. They buy the Highest-Priced Lamp sold in Canada, and get the best.

GRAND TRUNK
27980
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27980
Loaded with SUNBEAM INCANDESCENT LAMPS
FOR THE MONTREAL LIGHT, HEAT & POWER CO.

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Main Office: TORONTO Factory at St. Catharines

P. S.—By the way, we make a full line of Miniature and Decorative Lamps.

MOONLIGHT SCHEDULE FOR OCTOBER.

Date	Light	Date.	Extinguish.	No. of Hours.
Oct. 1	6 10	Oct. 2	0 00	5 50
2	6 10	3	1 00	6 50
3	6 10	4	2 00	7 50
4	6 10	5	3 00	8 50
5	6 00	6	4 15	10 15
6	6 00	7	5 20	11 20
7	6 00	8	5 20	11 20
8	6 00	9	5 20	11 20
9	6 00	10	5 20	11 20
10	6 00	11	5 30	11 30
11	5 50	12	5 30	11 40
12	5 50	13	5 30	11 40
13	5 50	14	5 30	11 40
14	5 50	15	5 30	11 40
15	5 50	16	5 30	11 40
16	10 15	17	5 30	7 15
17	11 15	18	5 40	6 25
19	0 05	19	5 40	5 35
20	1 00	20	5 40	4 40
21	2 00	21	5 40	3 40
22	2 50	22	5 40	2 50
23	No Light	23	No Light	
24	"	24	"	
25	5 30	25	7 40	2 10
26	5 30	26	8 20	2 50
27	5 30	27	9 00	3 30
28	5 30	28	9 55	4 25
29	5 30	29	10 45	5 15
30	5 30	30	11 45	6 15
31	5 30	Nov. 1	0 50	7 20
		Total	....	216 55

Upon the recommendation of Mr. J. M. Campbell, expert adviser, the City Council of Kingston, Ont., have decided to spend $7,700 on temporary repairs to the lighting plant acquired by the city. The general overhauling of the power house will not be started until next spring.

The Most Progressive and Up-to-Date Line in Existence.

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LIGHTEN YOUR LIGHTING PROBLEMS BY USING PACKARD LAMPS

We are making Packard Lamps better than ever these days and we want you to see how much better they really are than others. Order a sample barrel of lamps now and test them alongside the kind you are now using. Such a test will show you that the Packard Lamps have the best sustained candle power, most even rating and greatest ultimate efficiency.

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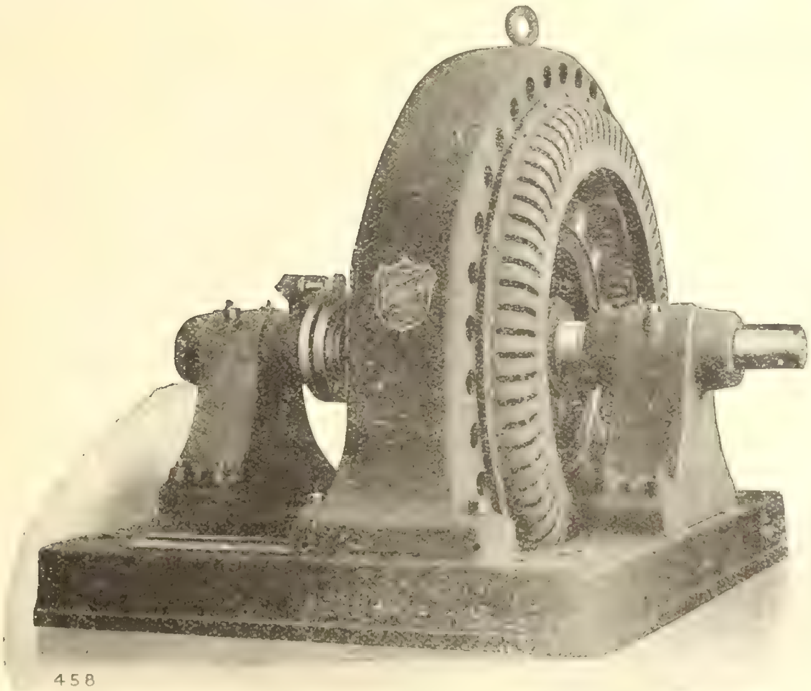
HIGH EFFICIENCY

MINIMUM OF HEATING



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IN CANADA FOR

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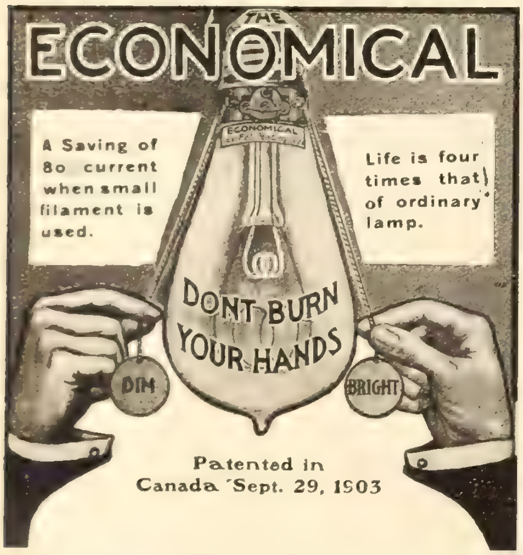
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CANADIAN
ELECTRICAL NEWS
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VOL. XIV. SEPTEMBER, 1904 No. 9.

The Power Equipment of the McClary Manufacturing Company's New Works at London, Ontario

JUDGING by the enterprise displayed by the McClary Manufacturing Company, of London, Ont., in the erection of their new works and power house, it is apparent that some of our Canadian manufacturers at least are awakening to the possibilities and advantages of electrical power for industrial establishments.

The McClary Manufacturing Company have been established in London, Ont., for over twenty-five years in the manufacture of stoves, furnaces, enamelled iron household utensils, tinware, etc. The old works are located near the G.T.R. depot at London and occupy approximately a block, but owing to the enormous increase of their business lately they have been compelled to double the capacity of their works, and in order to effect this they decided to erect an entirely new plant at some point where room would be available for future expansion. Accordingly, the firm selected a site on the north bank of the Thames River at the corner of Adelaide and Trafalgar streets, about a mile east of the old works.

The new works are devoted exclusively to the manufacture of stoves and furnaces and have a capacity of 50,000 stoves per annum. The buildings consist of a moulding shop, a stove mounting shop, a storage warehouse and an independent power house.

The new works have been laid out with the object of simplifying and expediting as much as possible the sequence of processes of the manufacture of stoves and furnaces, and the equipment has been arranged in such a way that the material in process of manufacture is received at one end and shipped from the other end of the works, thus avoiding the necessity of any piece in process of manufacture being carried back to any point it has once passed.

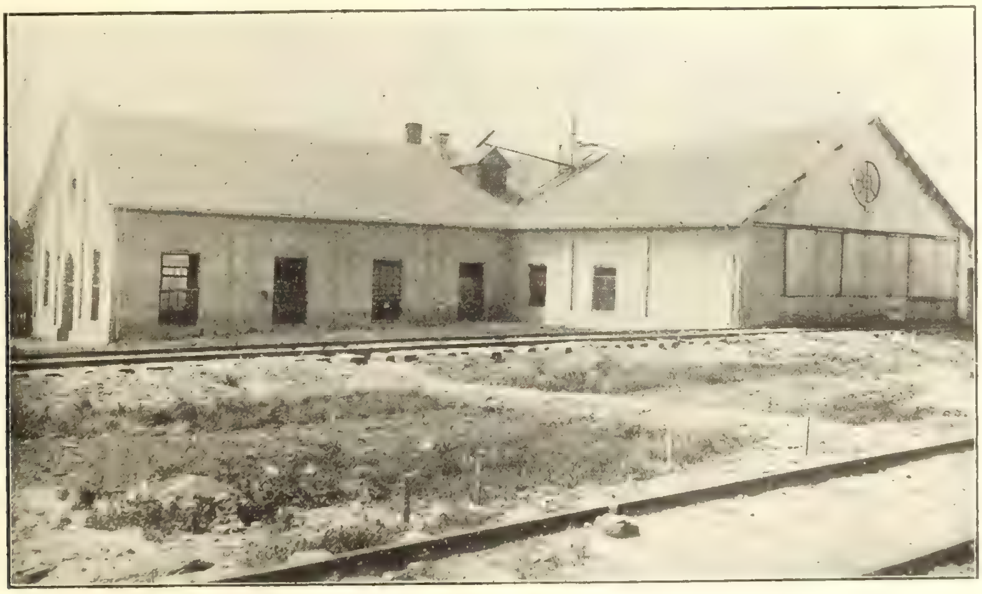

FIG. 1.—VIEW OF POWER HOUSE, SHOWING RAILWAY SIDING FOR COAL DELIVERY.

One of the most important elements of the thoroughness and efficiency of the plant is contributed by the electrical equipment, the various machines in the works being arranged in groups, similar machines being in one group driven by a single line shaft driven by an individual motor attached to the ceiling or placed in such position above the floor as to be entirely out of the way. The result of this distribution of power is that the line shafts have been placed in the most advantageous positions to give ample room, light, and convenience. The difficulty so frequently met with in industrial establishments, namely, the laying out of the line shafting and the counter shafting in such a way that all will form a unit driven by one or two engines, has been entirely dispensed with, with the result that the company have one of the cleanest, best lighted, best ventilated and most efficient industrial plants to be found anywhere. Although the new works have been in operation scarcely more than a year, the company have already had reasons to appreciate the advantage and economy of the system of distributing power throughout the works by individual motors and line shafts, over that of the old method.

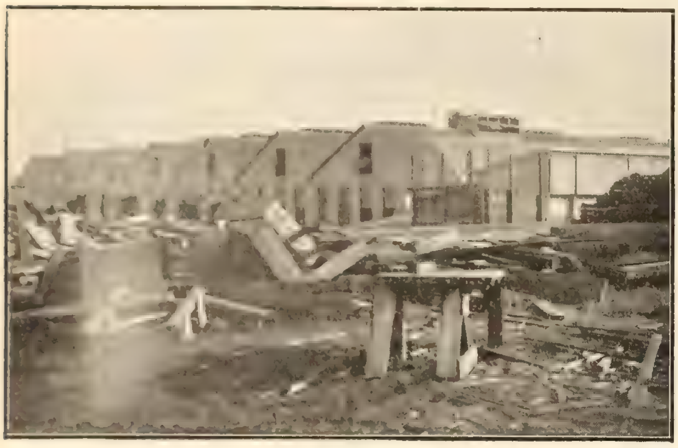

Fig. 2.—Exterior View of Foundry, Showing "Saw-Tooth" Roof Construction.

The buildings were designed by and erected under the supervision of Messrs. Moore & Henry, architects, London, Ont., and the power plant and electrical distribution system and equipment were designed by and installed under the supervision of Mr. Roderick J. Parke, consulting electrical engineer, of Toronto.

The moulding shop or foundry, in which the first process of stove construction takes place, is situated at the north-west corner of the property, and is 200 feet wide by 220 feet long, one storey high, built of white brick with concrete foundations and having a roof of the saw-tooth variety, as shown in Fig. 2, the glass sides of the roof being exposed to the north, giving all the light desired without exposing the workmen to the direct rays of the sun. The moulding shop has a concrete floor ; across the south end and divided from the moulding room is the milling room containing the tumblers and core ovens. A Colliau cupola having a melting capacity of 10 to 12 tons of iron per hour is located in the centre of the moulding shop, as shown in Fig. 4. The charging platform is constructed of steel and concrete to support a track from the cupola to the north wall of the building at which the pig iron and coke are received from the railroad cars which are taken in on a siding especially constructed for the purpose, the moulding shop being located in such position as to take advantage of a hill at the north side, thus enabling the railway cars to be shunted up to the level of the charging platform. The progress of the material and product through the moulding shop is direct and continuous, toward the mounting shop.

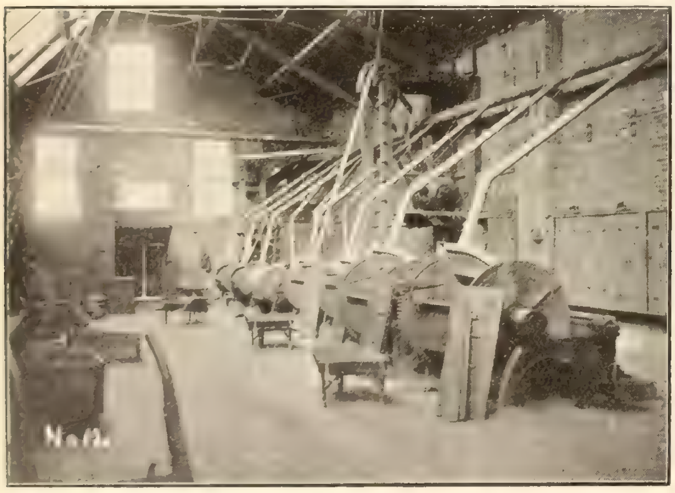

Fig. 3.—View of Portion of Milling Room, Showing Tumbler Group Driven by Motor.

The blast for the cupola is furnished by a No. 6B Green positive rotary pressure blower made by the Wilbraham-Green Blower Company, Philadelphia, driven by a 50 h.p. Bullock motor connected to the blower by means of a 12 inch Morse silent chain. In the milling room are two groups of tumblers driven by a 35 h.p. Crocker-Wheeler motor and a dust exhaust fan driven by a 5 h.p. motor. (See Fig. 3.)

The mounting shop, located about 200 feet east of the foundry, is 307 feet long by 32 feet wide, two storeys in height ; the walls are built of solid concrete, and the floors of steel and concrete, being of absolutely fire-proof construction. Between the foundry and the stove mounting shop is the pattern storage warehouse, 130 feet long by 40 feet wide, one storey high.

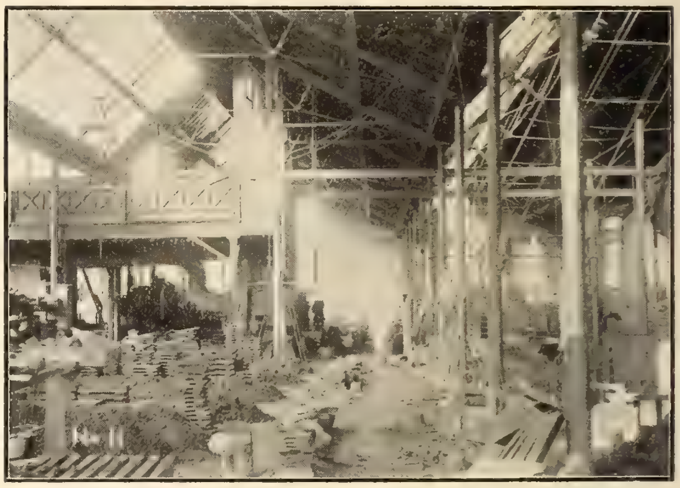

Fig. 4.—Interior View of Foundry, Showing Cupola and Charging Platform.

On the first floor of the mounting shop are the departments devoted to drilling and punching, shearing, finishing castings, assembling and finishing of parts and shipping, and on the second floor nickel polishing, nickel plating, stove mounting, stove blacking, and finishing.

The motor equipment of the mounting shop consists of a 50 h.p. type H, a 35 h.p. type B, a 24 h.p. type N and a 10 h.p. type B Bullock motors, three 15 h.p. and one 10 h.p. type C.E.4 Canadian General Electric motors, also one 10 h.p. and three 5 h.p. motors made by the Electrical Construction Company of London, Ont.

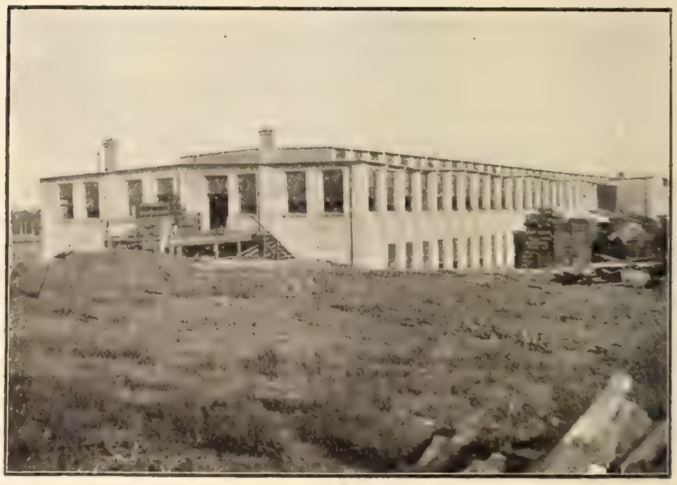

Fig. 5.—Exterior View of Stove Mounting Shop, Showing Concrete Construction.

All of the motors in the mounting shop are supported on or near to the ceiling so as to occupy as little useful room as possible. Each motor is controlled by a Cutler-Hammer motor starter with automatic no-voltage release. Push buttons are installed at various points so that a motor can be instantly stopped in the event of an accident occurring or a quick shut-down becoming necessary.

Direct current is distributed throughout the buildings to the various motors and lamps, at 230 volts. The works are illuminated by means of Adams-Bagnall 3.5 ampere 230 volt arc lamps, and 230 volt incandescent lamps. Separate circuits are provided between the power house and the shops so that separate control is had at the switchboard for the lamps and motors in the moulding shop and the mounting shop. Sub-distribution panels are located in the shops for the separate local control of incandescent and arc lamp circuits and certain of the motor circuits, thus affording a very flexible system with a minimum amount of wiring and maximum simplicity.

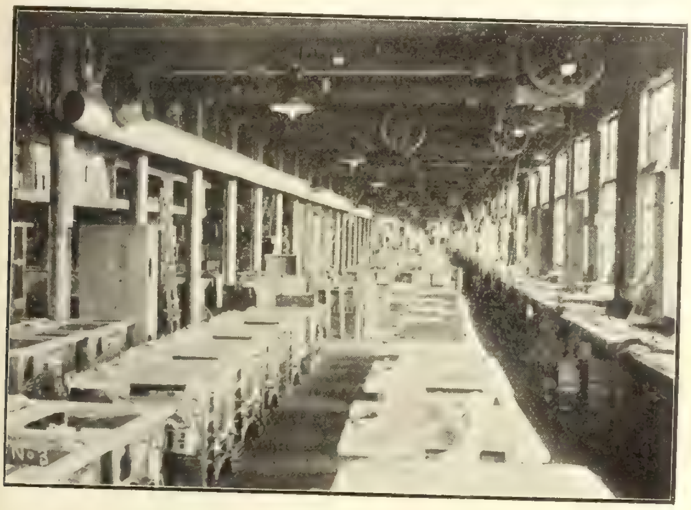

Fig. 6.—Interior View of Mounting Shop, Showing Erecting Department and "Hot Blast" Heating Conduit.

The power house is located on the north bank of the River Thames 300 feet south of the mounting shop. It is built of white brick one storey high with concrete foundations and concrete floors, and is 104 feet long by 35 feet wide, with a wing 56 feet long by 44 feet wide for the storage of coal, this wing being in such position as to take advantage of the natural gradient, permitting the railroad cars to be shunted to the north end of the coal house so that the coal can be dumped directly from the cars into the coal bunkers. The power house is divided into a boiler room 49 feet 6 inches wide by 26 feet long, and an engine room 56 feet 6 inches long by 49 feet 6 inches wide. In the dynamo room, adjacent to the south wall of the building, is the condensing pit 20 feet square by 8 feet deep, shown in Fig. 12.

The boiler equipment consists of three 100 h. p. standard internal fired Scotch boilers, manufactured by Messrs. E. Leonard & Sons, London, Ont., and constructed for 160 lbs. working steam pressure. They are 15 feet 9 inches in length over all, exclusive of the smoke box. The shell of each boiler is 84 inches inside diameter, made of 19/32 inch steel plate. There are 56 tubes 3½ inches outside diameter and 12 feet 6 inches long. Each boiler is equipped with a Morrison suspension type corrugated steel furnace, 40 inches inside diameter by 12 feet 2¾ inches long and 7/16 inches thick, and a Jones underfeed mechanical automatically operated stoker, which with the induced draft equipment affords an available capacity of 150 h.p. from each boiler when required. When the fourth boiler, for which space is provided, is installed, the total plant capacity will be 600 h.p.

A Green fuel economizer has been installed to operate as a part of the steam plant. This economizer contains 1920 square feet of heating surface and is divided into 40 sections, each section containing four tubes 4 9/16 inches external diameter and 9 feet long. The economizer is provided with a safety valve 2¼ inches diameter and a blow-off valve 3 inches in diameter, and the front or face of the machine consists of 10 sectional removable covers 2 feet 5 inches wide with 2 inches of asbestos lining. Each section of the economizer was subjected to a hydrostatic test of 350 lbs. to the square inch before erection, and after the economizer was erected it was subjected to a hydrostatic test of 200 lbs. per square inch.

The advantage of the economizer is apparent, in view of the fact that when the plant is operating at full load the temperature of the feed water is raised from 112 degrees Fah., at which temperature it is received from the exhaust heaters, to 260 degrees Fah., at which temperature it is delivered to the boilers.

The reader will notice on looking at the illustration the absence of a tall stack or chimney. Draught for the boiler furnaces is obtained by means of forced and induced draught combined, the forced draught being supplied from a 30 inch three-quarter housing bottom horizontal discharge Buffalo Forge Company steel plate fan delivering air at 2 ounces pressure into an underground pipe leading to the underfeed stokers. This fan is driven by a 6 in. x 6 in. horizontal high speed engine supplied by the Robb Engineering Company, Amherst, N.S. This engine is shown below the induced draft fans in Fig. 10.

The induced draft is created by a duplicate fan apparatus furnished by the Buffalo Forge Company; the equipment consists of two 8 foot full housing-up blast steel plate steam exhausters, each being driven by a direct connected 4½ inch by 5 inch single vertical double acting engine having the cylinders below the shafts. The equipment is provided with water-cooled bearings, a sheet steel smoke chamber and a Y smoke outlet connection upon which the stack rests, the stack being 47 inches in diameter and 15 feet high, the top of the stack being about 40 feet above ground.

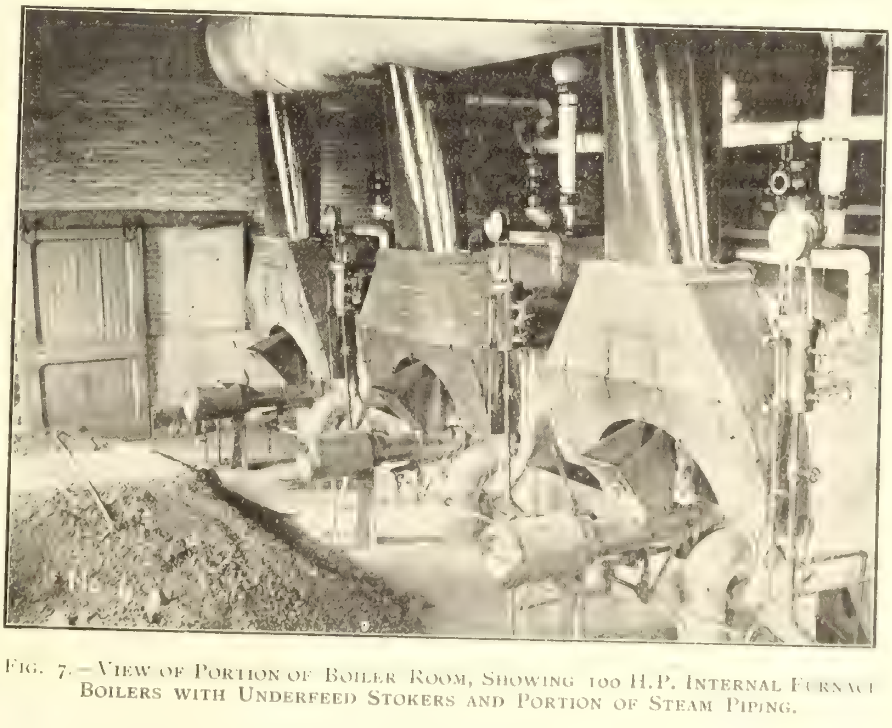

Fig. 7.—View of Portion of Boiler Room, Showing 100 H.P. Internal Furnace Boilers with Underfeed Stokers and Portion of Steam Piping.

The smoke breeching connecting the boilers, fuel economizer, and induced draft apparatus, is provided with by-passes and dampers arranged so that the economizer can be cut out of the smoke circuit at any time and the smoke turned directly from the boilers and through the induced draught fans to the stack. The induced draught fan engines and the stoker engine are controlled separately by two Foster automatic steam pressure regulating valves, so that when the steam pressure falls below a given point more steam is admitted to the engines, and their speed is increased with a corresponding increase in the draught, with a reversal of this operation when the steam pressure goes above the pre-determined point for which the valves have been set.

The generating equipment in the engine room consists of a 185 h.p. 12 in. and 20 in. x 14 in. Peerless self-oiling, centre-crank, automatic tandem-compound engine direct connected to a Westinghouse 250 volt direct current engine type generator, the speed of the unit being 250 r.p.m.; also an 11 in. x 10 in. Peerless self-oiling centre crank automatic 80 h.p. simple engine, direct connected to a Westinghouse 50 k.w. 250 volt direct current generator, the speed of this unit being 300 r.p.m. The engines were made by Messrs. E. Leonard & Sons, of London, Ont.

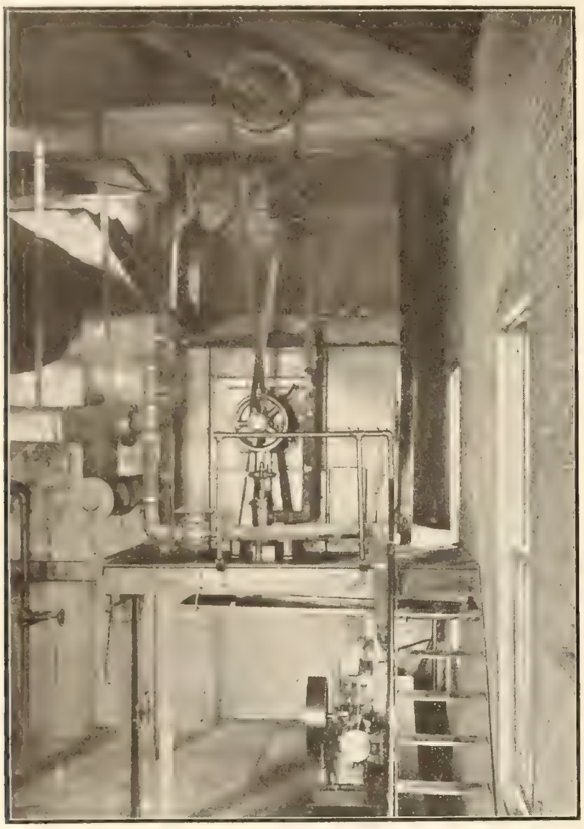

Fig. 8.—Induced Draft Fans, Showing Stoker Engine Below Platform, and Portion of Green Fuel Economizer at Left Hand.

The auxiliary steam plant equipment consists of two Northey independent jet condensers, one 8 in. and 12 in. x 12 in. for the tandem-compound engine, the other 6 in. and 10 in. x 12 in. for the 75 h.p. engine; two outside packed plunger boiler feed pumps each 6½ in. and 4⅛ in. x 8 in., one 200 h p. and one 80 h.p. Laurie closed type feed water heater, and a full equipment of Bundy automatic steam traps.

The water used for condensing is drawn directly from the Thames River and is allowed to run to waste, as in view of the adoption of other methods of utilizing the waste heat the advantages of having a hot well are so small that its use is not warranted. Owing to the poor quality of the Thames River water for boiler feeding, the feed water supply is obtained from a creek across the river, this creek furnishing practically pure water. The different sources of water, including that of the creek, the river, and an artesian well sunk on the premises, were analyzed, with the result that the creek water was found to be very suitable for boiler feed. Accordingly, a special conduit was run across the bed of the Thames from the creek to a settling basin at the power house, from which the feed water is drawn. A special connection is provided with the city water mains to provide a reserve for use in the event of repairs being required for the regular feed-water supply system. The feed water is forced by the pumps, through the heaters, thence directly to the Green fuel economizer, thence into the boilers. Bypasses are provided in the feed water line so that any heater and the economizer can be cut out of service when required. A feed water thermometer is provided at the outlet of each heater, also at the outlet of the economizer and on the main feed water line between the heaters and the economizer, thus enabling the attendant to determine instantly and accurately the value of the work each individual heater is doing, as well as the net results of the combined operation of the feed water heating system.

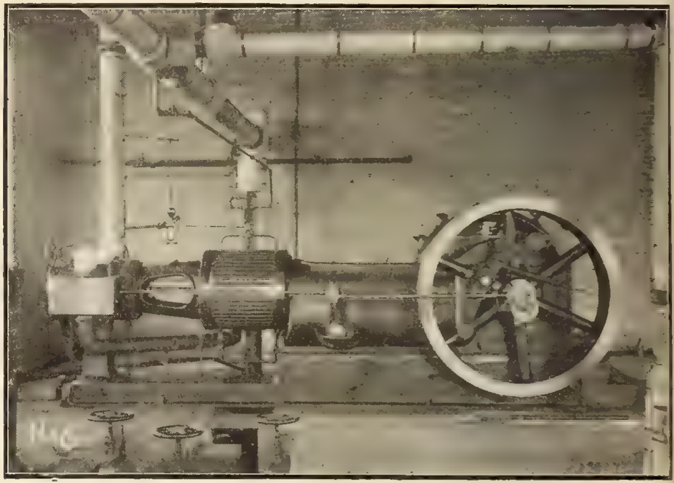

Fig. 10.—Side View of 175 h. p. Compound Engine and Generator.

The engine exhaust is arranged as follows: The 75 h. p. engine and 50 k. w. dynamo unit is used only when a melting-heat is in progress and when required for lighting the works. The exhaust from this engine is connected directly to its condenser, but a branch and valves are provided so that the condenser can be cut out of service and the exhaust turned directly into the works heating system. An automatic relief valve to the atmosphere is provided between the engine and the condenser, this valve being adjustable to give any desired back-pressure within ample limits when the steam is being supplied to the factory heating system.

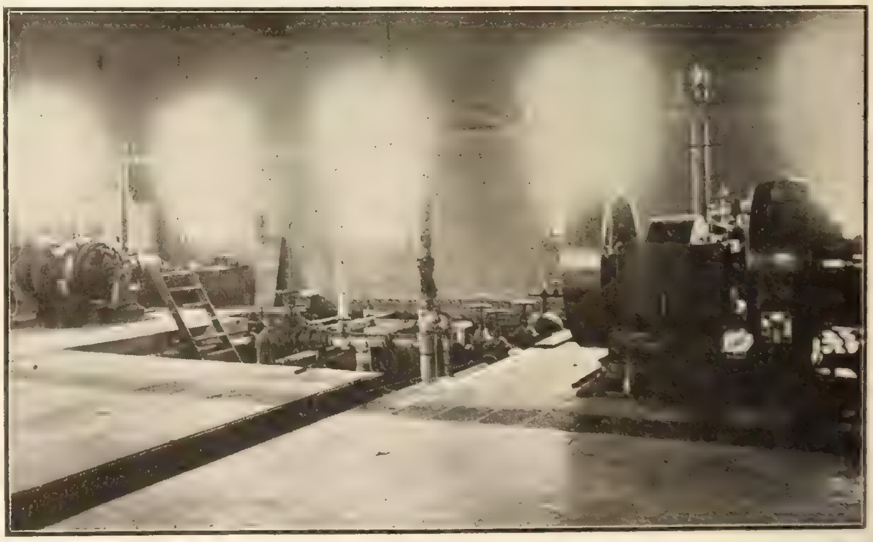

Fig. 9.—View of Engine Room from Switchboard.

The exhaust from the 185 h. p. tandem compound engine can be turned directly into its condenser, or directly into the factory heating system, or to the atmosphere, as may be required. A branch is provided to the 200 h. p. feed water heater, which latter can be run under a vacuum or at atmospheric pressure or cut in or out of service, as may be required.

The exhaust steam for the induced draught fan engine, the mechanical stoker engine, the condensers, and the boiler feed pumps, is run into a common exhaust pipe leading into the 80 h. p. heater, on the outlet of which is placed a vent pipe to the atmosphere, with an adjustable back-pressure valve on it. The exhaust steam from the auxiliaries is not condensed since it is utilized to better advantage in heating the feed water passing through the 80 h. p. heater. The temperature of the feed water from the small heater with the plant running under normal conditions averages 210 deg. Fah., and the temperature of the feed water passing through the 200 h. p. heater while the large engine is running condensing averages 110 deg. Fah. When the large engine is running non-condensing the temperature of the feed water averages 210 deg. Fah. It will be apparent from the above description that the auxiliary plant as designed affords full facilities for operating the power plant under the most economical conditions during the winter and summer season, in addition to permitting advantage to be taken of the exhaust steam for heating the shops in winter, and of condensing in summer.

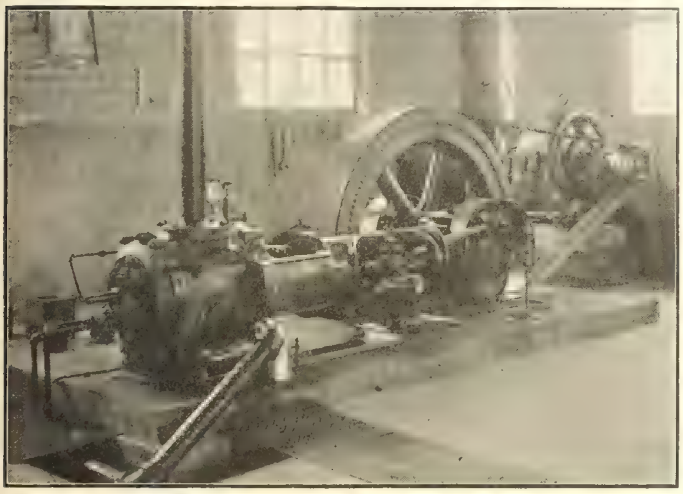

FIG. 11.—AIR COMPRESSOR AND MOTOR.

The switchboard equipment consists of two generator panels and a feeder panel, of blue Vermont marble, 65″x24″x2″, with sub-panels 25½″x24″x2″, each generator panel being equipped with an I-T-E "Dublarm" automatic double-pole 250-volt circuit breaker, connected so that it is impossible to accidentally short-circuit either generator, the function of the circuit breakers being that the single poles of each breaker open and close independently of each other, so that in the event of a short circuit or overload remaining on the generator circuit after the breaker has been thrown open, the closing of the second pole will immediately open the other. These circuit breakers were made by the Cutter Electric Company, Philadelphia, and are adjustable for a capacity of 50 per cent. above and below the rated capacity of the respective generators which they are intended to protect. A double set of busbars with double throw switches has also been provided on the switchboard and the connections arranged so that the generators can be operated independently or in parallel. This provision has been made with the object of providing an independent control for lamps and for the 50 h.p. cupola blower motor in the foundry, as it is necessary to vary the speed of this motor at times, the variation of speed being secured by manipulation of the generator rheostat on the switchboard. When the cupola is in operation, the 50 k.w. unit and the 50 h.p. motor operate as an independent combination, a special pair of mains being run from the switchboard to the cupola for this purpose.

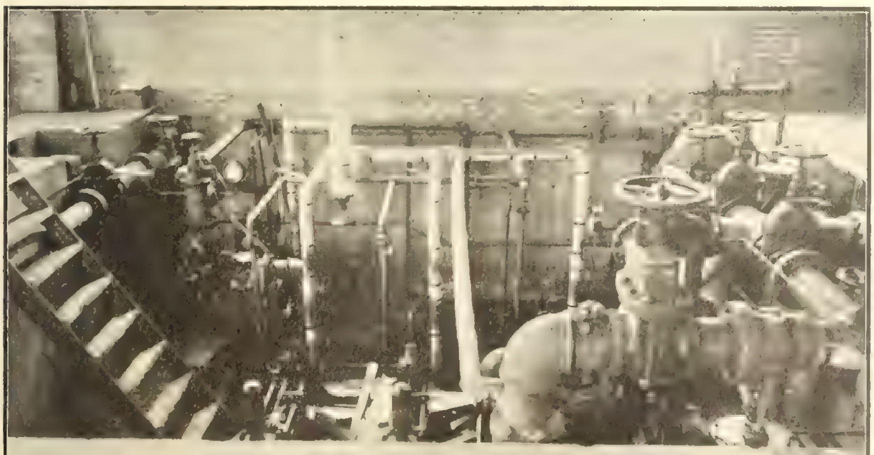

FIG. 12. VIEW OF CONDENSER PIT.

MR. RODERICK J. PARKE,

Consulting Electrical Engineer, Toronto, Who Designed the Power Plant and Equipment for the McClary Manufacturing Company.

The circuits between the dynamos and the switchboard are run in trenches built into the floor, these trenches being covered with cast-iron checkered plates. The conductors are rubber-covered and are supported upon split porcelain insulators held in position by iron clamps fastened by screws to 3″ × 3″ vertical wood strips set into the concrete flush with the walls of the trenches. The outgoing circuits from the power house are run underground through a brick tunnel. Forming a part of the switchboard is a gauge panel upon which are mounted a 10″ engine room clock, an 8″ boiler pressure steam gauge, an 8″ steam gauge connected to the receiver between the high and low pressure cylinders of the compound engine, and two 8″ compound vacuum and back pressure gauges, one connected to the exhaust pipe from each engine.

For furnishing compressed air for operating the pneumatic hoists and other pneumatic machinery used in the works, a class D-2 10″ × 16″ × 12″ Canadian Rand Drill Company air compressor has been installed. This compressor is driven by belt from a 40 h.p. Westinghouse direct current motor. This compressor is designed as a compound machine, the high-pressure or 10″ × 12″ half being installed at present, the foundations being so arranged that the low pressure or 16″ × 12″ half can be installed when required. The capacity of this compressor is 446 cubic feet of free air per minute at a speed of 120 revolutions per minute.

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The Telephone in Railroading

At the last convention of Railway Telegraph Superintendents, held in Indianapolis, some discussion took place on the possibility of the telephone being more generally used in railway work. Several well-known telegraphers gave it as their opinion that, owing to the many improvements that were being made in telephonic apparatus, it was likely to supersede the telegraph system to some extent. That events are working in this direction is shown by the fact that on September 7 last the Pittsburg Railways Company made a final test of the portable telephone for street car use, the test being found satisfactory as far distant as the inventors could get from Pittsburg by trolley, which was thirty miles. The overhead trolley wire is used for transmitting. Each car is supplied with a portable telephone hung in a neat box, which can be used from any pole along the entire line. From each pole hangs, within six feet of the ground, a "jack," into which the conductor or operator places a plug, and by pressing a button the telephone bell rings in the main office of the company in Pittsburg, when connection can be made with the main central. The invention is the work of Superintendent James W. Boden, of the Pittsburg Railways Company.

Use of Superheated Steam.

A late consular report from Germany, gives some particulars regarding the use of superheated steam in that country, showing that very satisfactory results have been attained. The first experiments were made with stationary engines, but during the last few years some of the State railways have been equipped with the Schmidt superheater, which is the one most commonly used. On a trial between Sommerfeld and Berlin the performance of a twin locomotive using superheated steam and of two similar compound locomotives using ordinary steam showed that the engine with the superheater effected a saving of 10.9 per cent. in the quantity of coal used and of 25.8 per cent. in the amount of water used. The engine with superheater also made much better time at starting than the compound engines at the fifteen stations where the train stopped, and climbed the grades at a greater speed. Based on the amount of steam produced, it was estimated that the real saving in coal should have been 15.3 per cent. instead of 10.9 per cent., the saving actually attained. Most exhaustive comparative tests were also made by the management of the Stadtbahn, of Berlin, whose lines run through and around the city. Three engines of types considered best adapted to the service of the railroad were tested under conditions as nearly alike as possible, and the locomotives using superheated steam gave much better results than the ordinary engines. It is pointed out that engines using superheated steam gather speed much more rapidly at the start than other locomotives and are therefore especially adapted for urban traffic. The report states that the compound engine can be replaced by the simpler twin engine, with increase of power and lower pressures in the boiler, which fact would seem to warrant the use of superheated steam even if no economy in fuel were attained. In America the utilization of superheated steam has not made progress owing to difficulties in lubrication. It seems that this trouble has been largely overcome in Germany, and it should, therefore, not be regarded as an obstacle to further experiment on this side. We understand that one of the the Canadian railroads is now experimenting with a locomotive equipped with the Schmidt superheater and that the results are being awaited with considerable interest.

The International Electrical Congress.

The International Electrical Congress which is to be held in the city of St. Louis, Mo., during the entire week beginning September 12th promises to be the most important assemblage which has taken place during the history of electrical science. Visiting engineers have arrived in large numbers from Germany, France, England, Italy and Switzerland, the Institution of Electrical Engineers of Great Britain alone being represented by 75 members. Never before has such an opportunity been offered to learn through personal contact the views of such a large number of distinguished electricians and to discuss the relative merits of different systems with their respective advocates. In response to invitations to join the Congress, 1,956 acceptances had been received by August 31st, of which 1,560 are from North America and 396 from other countries. The American Institute of Electrical Engineers have arranged a trip of inspection for their guests, the intention being to visit Schenectady, Pittsburg, Niagara Falls, Montreal, and other important electrical centres. The committee in charge have received the promise of about 170 papers, 77 of which are already in hand. These have all been submitted by request and they will doubtless form the most interesting volume of transactions which has yet been compiled. It is the intention that immediately after the opening the Congress will be divided into eight sections, as follows: Section A—General Theory. Section B—General Applications. Section C—Electro-Chemistry. Section D—Electric Power Transmission. Section E—Electric Light and Distribution. Section F—Electric Transportation. Section G—Electric Communication. Section H—Electrotherapeutics. Sections B D and E will likely be found of most interest to practising electrical engineers and central station and electric railway managers. The papers arranged for section B, as given in the preliminary programme, include one on "Electric Motors in Shop Service," by C. Day, and another on "Very High Voltage Transformers," by Prof. H. B. Smith. Dr. A. E. Kennelly and S. E. Whiting will read a paper on "The Present Status of the Edison Storage Battery" before Section C. Under Section D we find many important papers, among which we might specially mention "High-Potential Long-Distance Transmission and Control," by F. G. Baum; "The Construction and Insulation of High Tension Transmission Lines," by M. J. Gerry, jr.; "Some Practical Experiences in the Operation of Many Plants in Parallel," by R. F. Hayward; and "The Maximum Distance to which Power can be Economically Transmitted," by Ralph D. Mershon. Before the Electric Light and Distribution section will be read upwards of thirty papers, including "The Superiority of the Alternating Current for Distribution in Large Cities," by Dr. G. Stearn; "Commercial Limits of Electric Transmission with Special Reference to Lighting Service," by Sig. Ing. Guido Semenza; "Electric Transmission and Distribution for Suburban Towns from a General Power Station," by Herbert A. Wagner; "The Effect of Steam Turbines on Central Station Practice," by W. L. R. Emmet. "The Storage Battery in Electric Railway Service," by A. G. Entz, will probably be one of the most practical papers submitted before the Electric Transportation Section. Persons interested in electric communication will find much food for thought in the papers to be presented before that section. In Section G the subject of "Automatic Versus Manual Telephone Exchanges" is to be discussed by Kempster B. Miller, and "The Telephone Problem in Large Cities" will be handled by Franz. J. Dommerque. We would like to mention other papers to be presented, but space does not permit. We hope that many Canadian electrical engineers will take advantage of the opportunity offered to attend the Congress, as they are certain to be abundantly repaid for the time and money involved.

ELECTRIC RAILWAY CONSTRUCTION.

It is announced that the Canadian Electric Traction Company, Limited, which was recently financed in London, Eng., for the purpose of constructing an electric railway from London, Ont., through the city of St. Thomas to Port Stanley, a distance of thirty miles, have awarded the contract for the equipment of the road to Bruce, Pebbles & Company, of Edinburgh, Scotland. There will be ten motor cars, all designed to operate at a speed of thirty miles an hour on the level and fifteen miles an hour on grades of one in twenty-five. Each car will have a seating capacity for fifty passengers and will be capable of hauling a freight or passenger trailer in addition. The value of the contract secured by the Scotch firm is upwards of $200,000.

This is the first contract ever given to a British concern for the equipment of a Canadian electric road. It is understood that power will be transmitted at 10,000 volts and will be stepped down to 1,000 volts for the motors. The Ganz polyphase system is to be adopted and the contractors claim it will show a saving of thirty per cent. both in first cost and operating expenses when compared with a single phase or a continuous current equipment.

As soon as the road from London to Port Stanley is completed, it is probable that a line from London to Hamilton will be constructed, making in all a distance of 160 miles.

LIGHTING OF THE WINNIPEG EXHIBITION.

Mr. W. Phillips, Manager of the Winnipeg Electric Street Railway Company, sends us the following communication, which explains itself:

WINNIPEG, 30th August, 1904.

Publishers CANADIAN ELECTRICAL NEWS.

DEAR SIRS,—We have to hand your August number of the ELECTRICAL NEWS in which you give a general write-up of the Dominion Exhibition at Winnipeg, and we wish to thank you for the complimentary mention of the street car service. We, however, wish to correct an item in connection with the Exhibition lighting where you say the current for lighting the Exhibition was supplied from the city plant and all details and arrangements in connection therewith were handed over to the E. S. Harrison Company, Limited. This is incorrect, inasmuch as the city plant did not supply any of the current for the Exhibition lighting, this being all supplied by the Street Railway Company, and in addition to supplying the Exhibition the Street Railway Company supplied 50 k.w. to the city for all their special illuminations. Kindly make correction accordingly in your next issue and oblige.

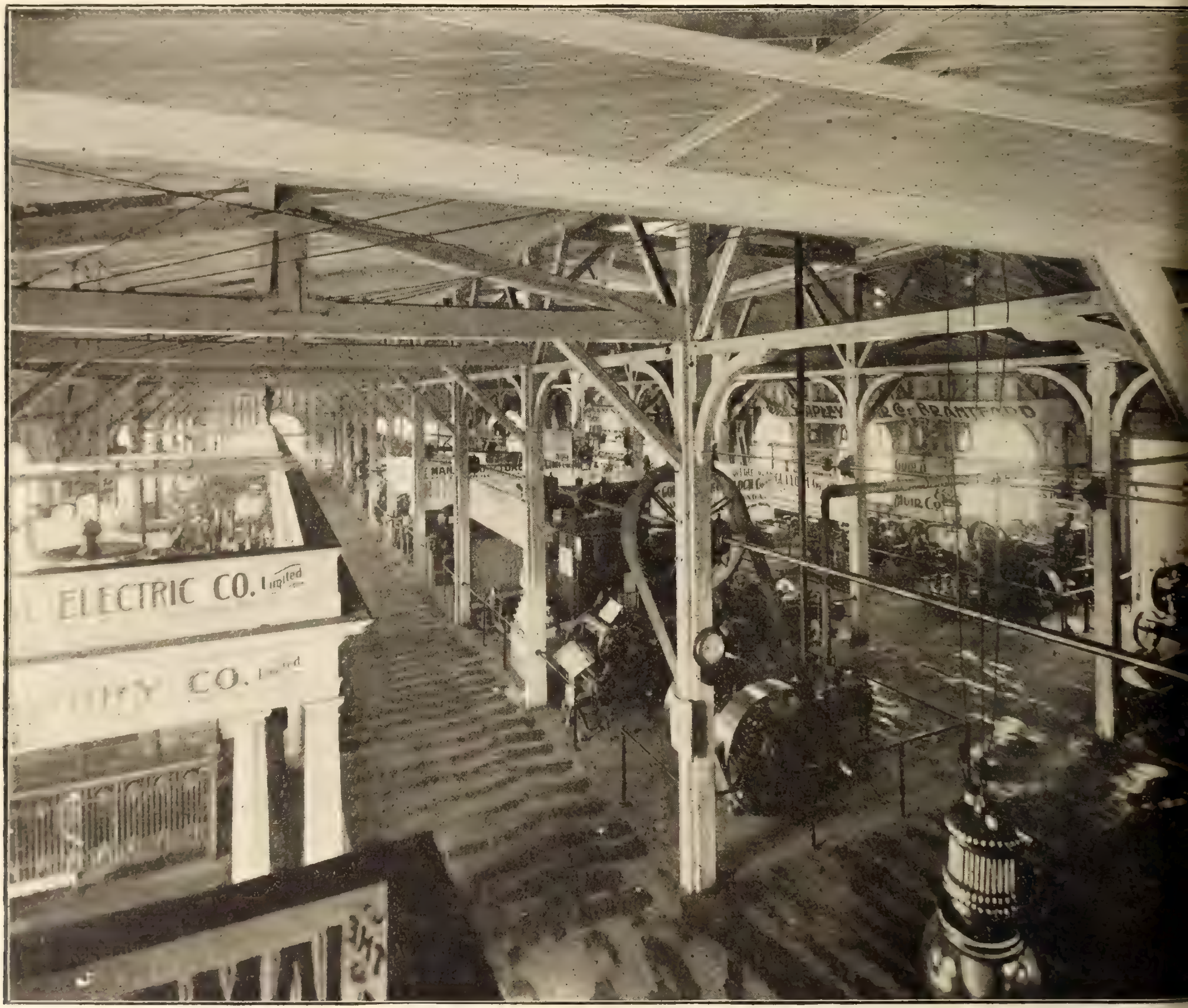
Yours truly,

W. PHILLIPS, Manager.

MACHINERY HALL AT THE CANADIAN NATIONAL EXPOSITION, TORONTO.

Upwards of fifty exhibitors are to be found in the Machinery Hall at the National Exposition now in progress in Toronto. Taken as a whole, the exhibit in this building is, without doubt, superior to that of any previous year both in point of general attractiveness and the variety of manufactures shown. The accompanying panoramic view will give the reader some idea of the character of the exhibits as well as of the general appearance of the building.

The most extensive exhibit is that of the Canadian General Electric Company and its associate concern, the Canada Foundry Company, of which an illustration and full particulars will be found on another page.



VIEW OF THE EXHIBITS IN THE MACHINERY HALL AT THE CANAD

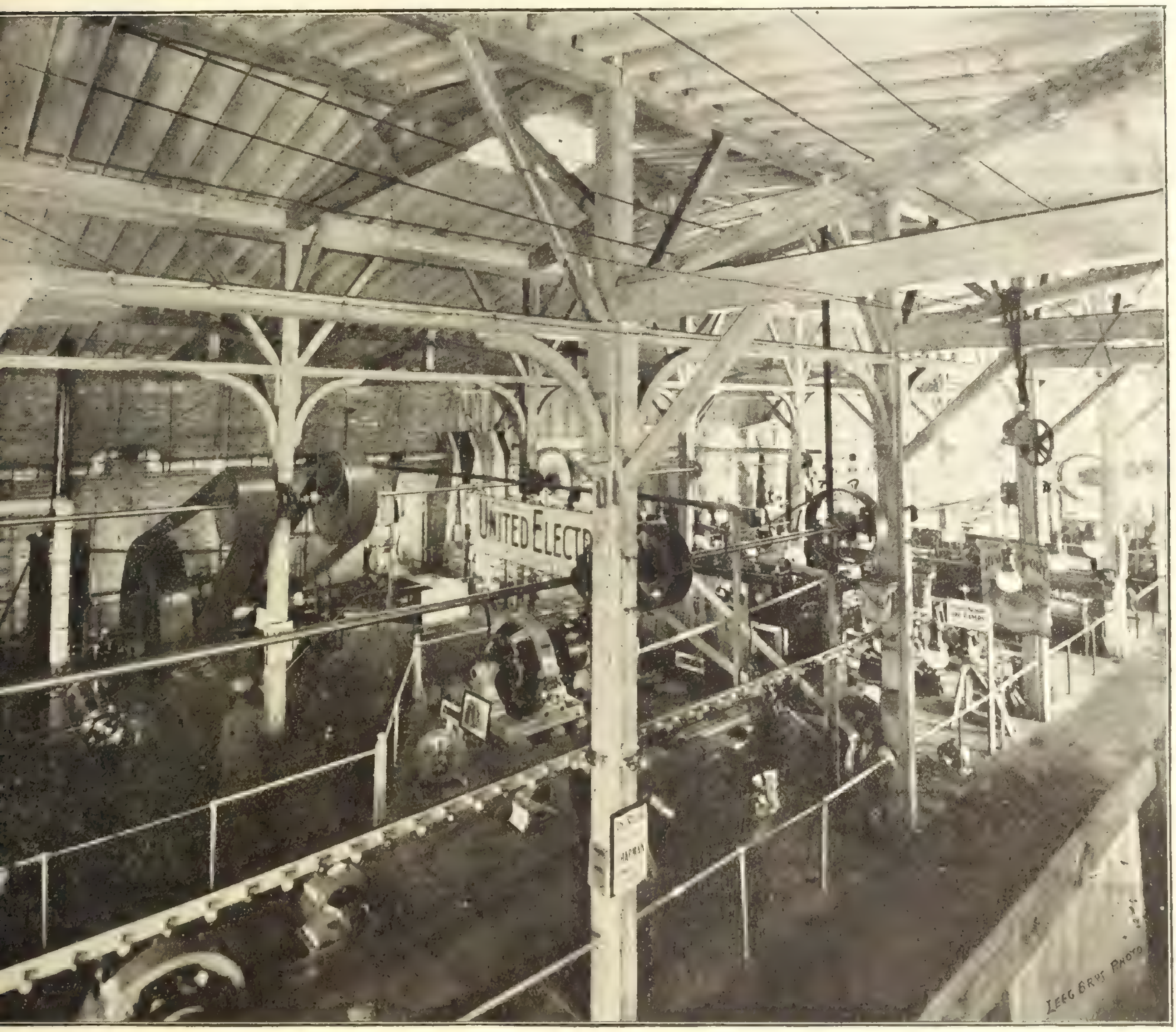
The exhibit of the United Electric Company, of Toronto, is very attractive and particularly interesting to central station men. It includes a 112 1/2 k.w., 500 volt, multipolar, direct current six-pole generator; one 50 k.w. m.p.d.c. 250 volt steel generator; one 12 k.w. 125 volt generator; one 6 k.w. 125 volt generator; one 25 h.p. induction motor; one 8 h.p. 250 volt motor, several smaller motors, and one 50 k.w. 200 volt alternating current inductor alternator of 1904 design. There is shown a complete switchboard equipment, including two marble generator panels and two distributing panels, also a full line of arc lamps, fan motors, telephones, etc. The exhibit is laid out as an actual working plant, the generators being under load and supplying current for the operation of motors in the Produce Building, Implement Hall, etc., as well as for special purposes such as focusing arc lamps, picture machines, and incandescent lighting in various parts of the grounds.

The Toronto & Hamilton Electric Company, of Hamilton, are exhibiting a line of direct current apparatus, including 15 k. w. and 7 1/2 k.w. direct connected dynamos, also three single phase motors, one 2-phase motor, switch-board instruments and supplies.

The Consolidated Electric Company, of Toronto, show a 40 h.p. direct current King Edward motor, operating at a speed of 775, which they claim is unsurpassed in efficiency and coolness of operation. They have also on exhibit a range of motors, switchboards, fan motors, and electrical supplies, including oscillating fans.

An attractive exhibit of electrical apparatus has been made by the Jones & Moore Electric Company, of Toronto. They show a line of bipolar and multipolar generators and motors from 3 1/2 to 80 h.p., and supply arc and incandescent lighting throughout the Machinery Hall. All motors are connected up. Their switchboards are handsomely decorated and are equipped with double-throw, double-pole, quick-break switches, the arrangement of which is quite unique. Not the least interesting feature of their exhibit is the display of Adams-Bagnall arc lamps and special lamps. Direct and alternating current fans and a full line of electrical house furnishings, telephones, etc., complete a very creditable exhibit, which is artistically lighted by colored incandescent lights in such a manner as to produce a most pleasing effect.

The McLachlan-Joy Electric Company, 201 Queen street east, Toronto, are showing a 15 k. w. dynamo to operate at 800 revolutions, a 30 k. w. 500 volt motor, 5 h. p. 110 volt motor, 6 h. p. bipolar motor and a 6 h. p. multipolar ceiling motor, also a marble switchboard and instruments. The exhibit of the McLachlan Gasoline Engine Company includes a gas engine of 8 h. p. operating a 4 h. p. steam engine from the waste heat of the gas engine, also a threshing engine of double cylinder type and six gasoline engines of various sizes.



EXHIBITION, TORONTO, AUGUST 28 TO SEPTEMBER 10, 1904.

The power for the main drives in the Machinery Hall is supplied by two Goldie & McCulloch engines, one being of the well-known Wheelock type, the other a high speed "Ideal" engine. The Goldie & McCulloch Company also show a 12-inch 4-sided moulder, new style power feed cut-off saw, new 30-inch double surface planer, four-sided moulder, milling separator, wheat steamer, boiler feed pump and several sets of Philbrick patent matcher heads.

A new exhibitor this year is the Georgian Bay Engineering Works, of Midland, Ont. Their display is confined to a 4 h. p. gasoline engine, of simple construction but fully guaranteed. They manufacture stationary, portable and marine gasoline engines for all purposes and make a special engine for electric plants, for which they guarantee a minimum of variation from no load to full load. This company also manufacture automatic towing machines, mine hoists and contractors' plant, and intend this winter to take up the manufacture of steel launches.

Another new exhibitor is the Smart-Turner Machine Company, of Hamilton, who show steam pumps and gasoline engines from 1½ horse power upwards, also the Rogers shaking grate, which is claimed to be a greater fuel saver and to accomplish splendid results with slack coal. This company recently acquired the business of the Hamilton Motor Works.

The Goold, Shapley & Muir Company, of Brantford, Ont., also exhibit gas and gasoline engines, the range being from 3 h.p. upwards.

The almost entire absence of smoke from the chimney of the Machinery Hall is due to the fact that the boilers operating the machinery are equipped with the Jones underfeed stoker, which, in addition to being a smoke consumer, is a mechanical stoker, producing perfect combustion.

The large water tube boiler exhibited by Babcock & Wilcox, Limited, Montreal and Toronto, has been inspected by many persons interested in power. It is equipped with the B. and W. superheater, which they claim will reduce the fuel bill by 20 per cent. Boiler forgings, manhole covers, economizers, gauges, etc., complete the display.

The Dodge Manufacturing Company, of Toronto, have a very interesting exhibit of power transmission appliances. The shafting shown is fitted with the Dodge friction clutch and is attracting much attention. Dodge wood split pulleys are shown in all sizes, besides a complete line of couplings, hangers, ring, chain, and capilliary self-oiling bearings, machine moulded iron pulleys, etc.

Four belting firms are represented in the Machinery Hall. The J. C. McLaren Belting Company, of Montreal and Toronto, show a 36-inch 2-ply leather belt made for the Ingersoll Electric Light & Power Company ; a 24-inch belt made for the electric light plant at Mitchell, Ont., and a 48-inch belt for the Firstbrook Box Company,of Toronto. The latter belt is to operate on a Reeves pulley, which is shown in the Manufacturers' Annex.

In the exhibit of D. K. McLaren, of Montreal, are to be found leather belts of various sizes, made from oak-tanned leather, also belts made of a mixture of Batavia and rubber, for use in exposed places. English card clothing,cotton mill supplies, belt hooks, etc., are also shown.

The Dominion Belting Company, of Hamilton, show a stitched cotton duck belt five feet wide, of their well-known "Maple Leaf" brand, also smaller belts down to 1½ inches wide. The duck from which this class of belting is made is treated with a special preparation which gives splendid results.

The Rossendale Belting Company, of Manchester, Eng., whose Canadian office is at 59-63 Front street east, Toronto, have an exhibit of their M. A. Y. solid woven, anti-friction edged belting and the Jackson patent belt fasteners.

A varied line of goods is shown by the Fairbanks Company, of Montreal, who have a very interesting exhibit. The list includes their standard scales, asbestos disc valves, Thompson engine indicators, safety valves, Foster pressure regulating valves, steam gauges, gas and gasoline engines of horizontal and vertical types, Nicholson's patent compression couplings, ball and socket drop hammers, Fair wood split pulleys (made in Canada), compressed steel pulleys, Fair brand leather belting, Geipel steam traps, Burt exhaust heads, Warden oil filters and several other steam specialties. Of special interest is Goodison's magnetic igniter, a new and unique invention for the ignition of gas and gasoline engines by means of which all loose batteries commonly used for the ignition of such engines are done away with.

The Canada Metal Company, of Toronto, are again in evidence this year with a neatly-arranged exhibit of babbitt metals, stereotype metals, electrical zinc, solders for electrical purposes, fuse wires, lead pipe, etc. They claim to be the largest manufacturers of electrical zinc in Canada (from one ampere up), also to be making the largest and smallest lead pipe in Ontario. Their "Hercules" babbitt metal is guaranteed for all line shafting. The goods shown are all the product of the company's factory on William street, Toronto.

Babbitt metal comprises the main feature of the exhibit of the Syracuse Smelting Works, of Montreal. Their Manganese anti-friction metal is claimed to have no superior. Specimens of copper ore and the refined product are shown by their associate company, the Montreal Copper Company, who were the first in Canada to produce refined ingot copper. This was accomplished on February 12, 1904. This copper analyses 99.75 per cent. pure, which is a remarkable showing.

The Eureka Mineral Wool Company, of Toronto, are utilizing a considerable portion of their space to demonstrate the advantages of "Cling Surface" belt dressing, of which they are making a specialty. When treated with this dressing the friction of a belt is greatly reduced and the incidental expenses decreased. Mineral wool pipe covering, Daniels' perfect pistol packing, Florian fireproof deadening felt, and Paroid roofing are among the other articles exhibited by this company.

The Philip Carey Manufacturing Company, 100 Front street east, Toronto, are showing standard asbestos pipe covering, Magnesia flexible cement roofing, asbestos sheeting, etc.

One of the most brilliant exhibits in the Machinery Hall is that of the James Morrison Brass Manufacturing Company, of Toronto, which includes lighting fixtures in gas, electric and combination, in both bright gold and old brass finishes, bronze Newell posts, an electric binnacle for steamships and a wide range of plumbers' supplies. The Nethery flush valves exhibited are unique and possess many advantages.

Exhibits of roller bearings are again prominent this year, and great interest is shown in the practical demonstrations that are being made. The Henderson Roller Bearing Company, of Toronto, have in the centre of their exhibit a heavy roller weighing 5,628 pounds mounted on pedestals and running on roller bearings, and which is actually driven by a fine silk fish line. A three-ton railway truck is moved by 4 pounds 4 ounces of power. The Canadian Bearings, Limited, of Hamilton, are exploiting Wright's taper roller bearings, which they exhibit as fitted to buggy and waggon hubs, shafting, bicycles, and other mechanical devices. It is claimed that this bearing saves from 33 to 75 per cent.in motive power and 95 per cent. of lubricant. Besides their main exhibit, the Chapman Double Ball Bearing Company, of Toronto, have all the shafting in the Machinery Hall equipped with their bearings, which enables manufacturers to examine the bearings operating under the ordinary conditions that would be found in their own plants.

Messrs. Kerr & Goodwin, of Brantford, Ont., have a very fine exhibit of the "Imperial" lathe chuck, and Messrs. G. .S Sinclair & Sons, of Wiarton, Ont., exhibit Sinclair's patent shaft coupler for the transmission of power, the salient features of which are safety, no bolts, no keys, never slips. The holding power of it is increased as the strain on the shaft is increased, its grip being automatic.

Other exhibitors in the building include the C. Wilson Scale Company, of Toronto, scales, power meat cutters, and bread moulding machines; S. Vessot & Company, Joliette, Que., Champion feed mills; R. H. Buchanan & Company, Montreal, Erecson hot air engine; A. R. Williams Machinery Company, Toronto, woodworking machinery, mining machinery, machine tools, etc.; Wayland Williams, Roberts' filling machines for liquids, oils and paints; American Machine

Company, Newark, Del., hot air pumping engine; The Sheetz & Lynde Company, Toronto, sales agents, the von der Osten brick machine, of which Mr. E. von der Osten, consulting engineer, 9 Toronto street, Toronto, is the patentee.

In the exhibit of the Pease Foundry Company, of Toronto, in the Stove Building, we notice the "Allen" automatic air valve, which seems to embody several new features in the fact that it is absolutely automatic and non-adjustable and closes entirely by flotation. It is very simple in construction and specially applicable to low pressure steam heating.

MICA PRODUCTION IN CANADA.

There was produced from the mica mines of Ontario in 1903, according to the 1904 report of the Bureau of Mines, 948 tons of mica, worth $102,205. A decided change has come over the business of mica mining in this Province. Formerly a large number of small openings, hardly to be designated "mines," were spasmodically worked by their owners, mostly the farmers on whose lands they were situated, during their spare time, or when a rise in prices made it an object to bring mica to the market. Recently, modern business methods have been applied to the production of mica, and the number of properties worked has become much smaller, while at the same time operations have been on a larger scale and more steadily carried on. The output of last year was practically all from three mines, two of them, the Lacey and the Hanlan, owned by the General Electric Company, and the third, the Bob's lake, by Messrs. Kent Bros., of Kingston. Mr. J. W. Trousdale, of Sydenham, Mr. L. J. Gemmell, of Perth, and Messrs. J. Richardson & Sons, of Kingston, also produced smaller quantities, from the McClatchey, Donnelly and Freeman mines respectively.

The practice is now generally adopted of simply "rough-cobbing" the mica at the mine as it comes from the pits, and forwarding the product thus obtained to the trimming works, where it is graded, split and cut into marketable sizes and forms. The figures given above as to quantity and value of product represent the "rough-cobbed" mica, and not the output of the trimming works, which employ in the aggregate a large amount of labor.

Ontario and Quebec are perhaps the leading sources of mica supply on the continent, and furnish a very large share of the mica used in the manufacture of electrical apparatus. The variety yielded by both Provinces is almost entirely phlogopite or "amber" mica, the flexibility and resistance of which to the passage of the electric current render it most suitable for this purpose. It is exported principally to the United States, but, as is shown by statistics, quantities have of late years also gone to Great Britain, whose supplies in the past have been drawn mainly from India. Muscovite or white mica also occurs in both Provinces, but it is usually stiffer in quality and less amenable to the bending and shaping required in making the insulating parts of electrical machinery.

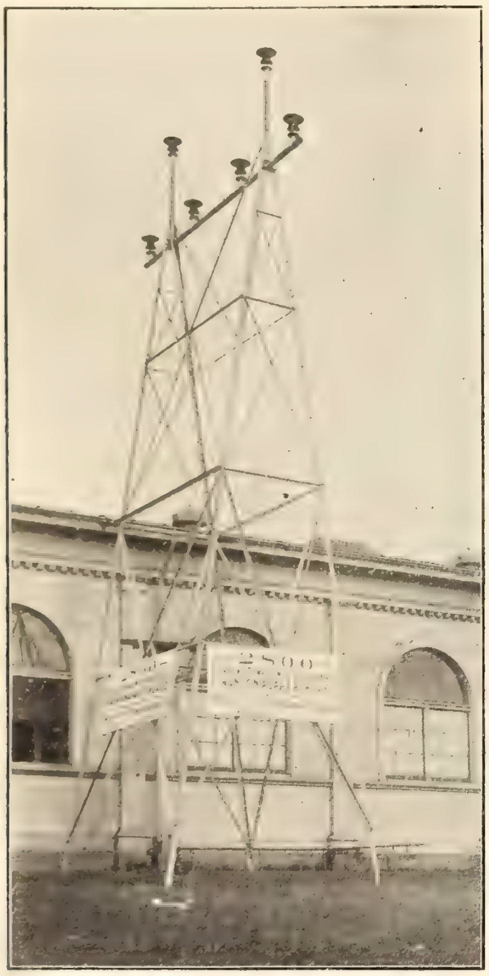
The disproportion which formerly existed between the value of the larger sizes of mica and the smaller sizes has to some extent been done away by the increasing manufacture of "micanite," in which pieces of mica of all shapes and sizes are built up by means of a shellac cement into any dimension and thickness required. These boards can be cut, planed and shaped with ease, and are almost, if not quite, as efficient in their insulating properties as the mica itself. In making "micanite," the quality, not the size, of the piece is the important consideration, and fragments down to 1 inch by 2 inches in area, which were formerly relegated to the scrap heap, are now made use of in this way.

The producing mica mines of Ontario are situated in the counties of Lanark and Frontenac, in eastern Ontario, but mica of what appears to be marketable quality has also been found in the districts of Nipissing and Parry Sound.

The Canadian Electrical Association at Power Glen, Enjoying Luncheon on the Lawn at the Superintendent's Residence, June 17th, 1904.

STEEL TOWERS FOR TRANSMISSION LINES.

The illustration herewith represents one of 2,800 steel towers which the Canada Foundry Company, of Toronto, are building for carrying the conductors of the Toronto and Niagara Power Company's transmission line from Niagara Falls to Toronto, a distance of eighty miles. These towers will extend along each side of the eighty-foot right of way, and will be spaced 400 feet apart. They are constructed of galvanized steel angles bolted together with bracing similar to the usual design of windmill towers. They will be forty-six feet high, having a base fourteen feet by twelve feet. Lengthwise of the line each tower will have a uniform width of fourteen feet from bottom to top, but crosswise the width of twelve feet at the bottom will diminish, the sides coming together at the top. A steel pipe will form a cross-bar, carrying four steel pins, on which insulators will be placed. The other two insulators will be placed on vertical steel pipes, so that the conductors of each circuit will form an equilateral triangle, with a horizontal base of six feet. The towers will be sunk about six feet in the ground, each foot resting on a cedar block, and braced with other blocks, upon which the earth will be solidly rammed. Wherever the nature of the soil demands it, a concrete foundation will be used. Towers will be bolted together in a horizontal position and raised to the vertical by means of a derrick.



One of the Steel Towers for the Toronto and Niagara Power Company.

The towers are designed to withstand a side strain of 10,000 pounds applied to the top. Where unusual conditions exist, special towers will be provided. At curves the towers will be placed at shorter intervals, and so constructed that they will withstand the strain without guys. At the crossing of the Welland Canal towers will be erected of special height to allow the passage of ships below the conductors, and the same will be done at the Hamilton Bay Gap. With few exceptions the line passes through a practically level country and presents few difficulties in construction.

The insulators will be glazed brown porcelain, made in three or four parts. The parts making up the insulator will be cemented together and the insulator cemented to the steel pin. The insulator will be about fourteen inches in diameter of top umbrella, and about fourteen inches high over all.

The transmission line will consist of four three-phase circuits, to be operated at 60,000 volts, two circuits being carried by each line of towers. The conductor will be composed of 6 strands No. 6 copper wire wound about a hemp core. The combined area of the strands is 190,000 circular mills, and a high conductivity with a high tensile strength and elasticity is obtained. Tests with this cable show that an elastic limit exceeding 35,000 pounds per square inch can be obtained with an ultimate tensile strength of 55,000 pounds per square inch. The cable, which will be supplied by the manufacturer in lengths of 3,000 feet, will be joined by twisted copper sleeves unsoldered, and copper tie wires will be used. Low temperature, wind, sleet, etc., have been provided for in the spacing of the towers and the amount of sag to be allowed. Lightning arresters of ample capacity will be placed at various points on each circuit, each arrester being provided with a knife-switch for disconnecting it from the transmission line.

ALCOHOL MOTORS AND PUMPS IN CUBA.

United States Minister Squires, of Habana, Cuba, writes as follows :

Matanzas, a city of about 40,000 inhabitants, has water connection in 1,700 out of 4,000 houses, which use about 100,000 gallons a day. The waterworks, operated by an American company incorporated in the State of Delaware, are located a few miles distant from the city, where there are springs giving excellent water in sufficient quantity to supply a city of 100,000 people.

The alcohol motor pump, used on Sunday last for the first time, is of German manufacture, and cost, complete with installation, $6,000. This motor pump is a 45 horse-power machine and is operated at a fuel cost of about 40 cents an hour, or $4 a day of ten hours, pumping 1,000,000 gallons of water.

As alcohol here is very cheap (10 cents a gallon), the running expenses of these motors are at the minimum. The Germans are selling in Cuba many such motors for electric lighting and water plants at very low prices. One firm has a contract to put in an alcohol motor pump at Vento, for use in connection with the Habana water supply, which is expected to develop 180 horse-power, to cost, with installation, about $25,000, and to pump 1,000,000 gallons an hour at a fuel cost of $1.60. The same firm has installed an electric-plant alcohol motor of 45 horse-power, which supplies 138 lights (Hersh lamps) at a fuel cost of 5 cents an hour.

The dissolution is announced of Finlayson & Cavers, electricians, Montreal.

Mr. Charles Brandeis, consulting engineer, has recently removed into commodious offices, Nos. 62 and 63 Guardian Building, Montreal.

Mr. W. F. McLaren, electrical engineer with the Westinghouse Mfg. Co. at Pittsburgh, Pa., was called home to Hamilton last week by the sudden death of his father.

EXHIBIT OF ELECTRICAL MACHINERY AND FOUNDRY PRODUCTS.

The largest space in the Machinery Hall at the Toronto Exhibition is occupied by the Canadian General Electric Company and the Canada Foundry Company, of Toronto, their exhibit consisting of four carloads of electrical machinery and foundry products covering a space of 120 feet by 14 feet. The exhibit is most admirably displayed and gives the visitor some idea of the vast range of products made by these companies.

Starting at the entrance of this building, first appears a display of cast iron pipe and special castings; following this a lrrge space is devoted to the electrical interests, and here the attention of the wireman is fixed as he looks with envious eyes on the display of electrical supplies in such a variety as has before been unknown to him. The ladies' attention is arrested by a display of electric cooking and heating apparatus. A full line of transformers is displayed, together with the core and coils used in their manufacture, demonstrating the method of insulation used in the manufacture of the well-known type "H"; also a complete line of direct current motors from 2 h. p. to 35 h. p., and standing nearby are two K10 railway controllers with the cover off, disclosing the mysterious working parts. A handsome marble switchboard forms the background.

On the wall is arranged a neat display of armature and transformer punchings and armature coils insulated ready to be placed in the machines. Next comes a display of waterworks supplies, consisting of hydrants, valves and valve boxes. The "Easy" injector and Beaver post hole diggers cause no little interest and have been shown and explained many times. A large and imposing pyramid of set screws and nuts next catches the eye, of which the variety is a surprise to even those mechanics who are constantly using them.

In the office was displayed views of the different factories and descriptive matter. A very handsome mantle illustrated the use of fire dogs, fenders and smoke guards to good advantage.

Then follows a line of the well-known "Northey" pumps: A "Triplex" pump 5″ × 8″ driven by a 10 h.p. motor supplying 180 gallons per minute for a water face, which is attracting much attention, not only from the mechanical standpoint, but being tastefully decorated with ferns and moss it is very much admired from an artistic aspect.

The products of the Subway Works are shown by a superb teller's cage, finished in matt copper with a counter railing of handsome design in a like finish. Samples of electro finishes are shown in endless variety, and a very choice selection of wrought iron andirons, fenders and fire screens attract much attention, the whole forming a display calculated to impress one with the conviction that Canadians have in their midst a source of supply in electrical and mechanical engineering lines equal to anything on the American Continent.

On the lawn was displayed an assortment of fountains, both ornamental and drinking, together with some handsome cast iron flower vases and lawn rollers, the whole enclosed by a neat wrought iron fence. Close by was erected one of the wrought iron towers used by the Toronto & Niagara Power Company in the electric transmission line from Niagara to Toronto.

Exhibit of Canadian General Electric Company and Canada Foundry Company at Toronto Exhibition.

Local parties have taken steps to secure a telephone line between Shelburne and Black's Corners, Ont. They desire that the Central Dufferin Telephone Company should undertake to construct the line.

Mr. Wain has been appointed chief engineer and electrician for the corporation of Kamloops, B.C., as successor to Mr. Marshall, who recently resigned. Mr. T. Shackleton has been promoted to the position of second engineer. This corporation owns and operates the electric light plant.

Referring to the fact that the Dominion Exposition was held at Winnipeg this year, and that last year Toronto was the point chosen, the Maritime Merchant points out that next year's Exhibition should justly be held in the Maritime Provinces. It is absolutely essential that the people of the different provinces should become acquainted with the possibilities of each province and as a means to this end a Dominion Exhibition should be held in the Maritime Provinces.

ENGINEERING and MECHANICS

ANNUAL CONVENTION OF STEAM ENGINEERS.

The annual convention of the Canadian Association of Stationary Engineers opened in the County Council Chamber of the Court House, Hamilton, Ont., on Tuesday, August 16th, when an address of welcome was delivered by Mayor Morden and responded to by President H. E. Terry. The following persons were in attendance :

H. E. Terry, president ; J. M. Dixon, treasurer ; W. Inglis, secretary, all of Toronto ; J. Ogle, Brantford, conductor ; F. Sculthorpe, Hamilton, door-keeper ; delegates, Toronto No. 1, A. M. Wickens, G. C. Mooring, W. McGhie, W. Outhwaite. Brantford No. 4, J. Ogle. Berlin No. 9, W. Oelschlager. Chatham No. 21, E. Grandbois. Dresden No. 8, W. Steeper. Waterloo No. 17, N. Beam. Hamilton No. 2, W. F. Crockett, W. A. Sweet.

MR. F. J. SCULTHORPE, Hamilton,
President Canadian Association of Steam Engineers.

The president's address contained several important suggestions, and is given in part below :

PRESIDENT'S ADDRESS.

Early this year it was found that Toronto No. 18 were having great difficulty in getting out their members to the meetings, and that there was great danger of them becoming defunct. After several meetings with the brothers, it was decided to effect an amalgamation with Toronto No. 1, and on March 8th No. 18 surrendered its charter, and the members were accepted in Toronto No. 1, and in view of the fact that No. 1 assumed the risks of No. 18, the cash in possession of No. 18 was turned over to No. 1.

I am pleased to report that on May 16th an Association was instituted in Chatham to be known as Chatham No. 21, with a charter of twenty-one members. Also on July 26th an Association was instituted in St. John, New Brunswick, to be known as St. John No. 22, with a charter list of 43 members. Both of these Associations are reported as doing well, and are in a fair way to become useful additions to our order.

I am pleased to report that Ottawa Association will be in working order again before the end of the year.

I would recommend that you take into consideration the matter of reducing the per capita tax of the Associations that are too far distant to be represented at this convention. Also that those Associations which do not pay sufficient tax to cover their representative's expenses, should pay one-half of his expenses.

I would also recommend the advisability of meeting every two years instead of annually.

During the year the secretary's correspondence and enquiries regarding the Association have been very large, the small amount of advertising done in the Canadian Engineer and the ELECTRICAL NEWS having brought forth fruit abundantly.

SECRETARY'S REPORT.

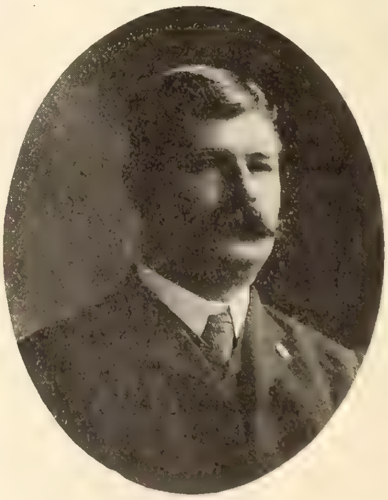
The secretary's report stated that the correspondence during the year had been very large, the advertisement in the Canadian Engineer and the CANADIAN ELECTRICAL NEWS having brought the order prominently before the public and engineers all over the Dominion. The recommendations of the secretary, in short, were as follows : 1. That a board of examiners be appointed by the Association to examine all members of the C. A. S. E. and grant them certificates of competency, according to their qualifications. 2. That a sick benefit fund be established by paying a limited number of weeks per year and by grading the members according to age, or by paying a flat rate per year. 3. That the per capita tax be raised to one dollar per year, or that less mileage and per diem be paid. 4. That a representative be appointed in each province in the Dominion to receive applications for membership and transact the business of the order in his province. 5. That members put forth greater efforts to increase the membership. There were admitted by initiation and new branches during the year 58 members, making the present membership 294. 6. The receipts during the year were $190.50 and the expenditure $68.10, leaving a balance of $122.40, which will need to be carefully dealt with to leave the Executive some funds to start the year's work on. The following standing committees were appointed : Mileage—N. Beam, W. Steeper. Ways and Means—R. J. Pettigrew, E. Grandbois, W. Outhwaite, W. A. Sweet, W. McGhie. Good of the Order—G. C. Mooring, W. F. Crockett, A. M. Wickens, J. M. Dixon, W. Steeper. Auditors—W. A. Sweet, J. Ogle.

Mr. G. C. Mooring gave notice of motion that the name of the Association be changed to the Canadian Association of Steam Engineers, and Mr. J. M. Dixon gave notice that the preamble of the constitution be amended so as to appeal more strongly to the mind of the enquiring workman.

Clauses 1, 2, 4, 5 and 6 of the Secretary's report were referred to the Committee on the Good of the Order, and clause 3 to the Committee on Ways and Means.

At the afternoon session the report of the Committee on Ways and Means on the president's address was received and adopted as read, also the report of the Auditors and the Mileage Committee.

Mr. F. B. Uttley, of the Goldie & McCulloch Company, gave an interesting talk on engineering, after which the delegates visited the Victoria Ave. sub-station of the Hamilton Cataract Power, Light & Traction Company, of which Mr. W.A. Sweet is superintendent, and the works and power station of the International Harvester Company. A special car was placed at the disposal of the Association by the Hamilton Street Railway Company. In the evening the members enjoyed a social time at the East End Incline. Mr. Robert Baker, of Hamilton, in a brief talk, described his patent perfect combustion automatic machine, which he claims will separate the impurities from the pure gases.



MR. W. A. SWEET, Hamilton,
Vice-President Canadian Association of Steam Engineers.

Upon resuming business on Wednesday morning a telegram was read from the International Union of Steam Engineers asking the co-operation of the Association in procuring a compulsory license law at the next session of the Ontario Legislature, which met with the support of the convention.

The report of the Committee on the Good of the Order was submitted, and the president's address, with the exception of the recommendation that meetings be held every two years instead of annually, was adopted. Clauses 1, 2, and 4 of the secretary's report were rejected, but the other recommendations were adopted. The per capita tax is thus increased from 70 cents to $1, this to apply to all branches within 400 miles of the place of meeting. It was resolved to change the name of the Association to the Canadian Association of Steam Engineers. The following preamble will take the place of the old in the new constitution:

"This Association having for its object the furtherance of mechanical and expert training of its members, endeavors to strengthen itself by encouraging a higher standard of skill among them.

"In the everyday work of the engineer, there comes an unconscious addition to his past experience by his application to new phases of his labor arising from the increased demands on the uses of steam. How best to acquire the knowledge to meet this march of events in our profession is the principal object of this Association. By means of instructive meetings and circular letters we intend to equip all members, and especially those who may locally be placed at a disadvantage. Fraternity is the spirit of love, and should guide our relations in life. Our labor is so closely identified with capital, that we wish to concede to it the position its commercial interests demand, but recognize the identity of interests between employee. Our intercourse should be marked with a preference for the furtherance of our progressive life, avoiding all subjects, such as politics or religion, which are man's own private thought."

At the afternoon session a motion was adopted that the Executive should make arrangements for the reading of at least two papers on mechanical subjects, and at least one on social relations, at the next annual meeting.

The election of officers resulted as follows: President, F. J. Sculthorpe, Hamilton; vice-president, W. A. Sweet, Hamilton; secretary, W. Inglis, Toronto; treasurer, J. M. Dixon, Toronto; conductor, W. Outhwaite, Toronto; doorkeeper, E. Grandbois, Chatham. The retiring president, Mr. H. E. Terry, was presented with a past president's jewel and was tendered a hearty vote of thanks for his efforts on behalf of the association, to which he fittingly responded.

Chatham was selected as the next place of meeting, and after a vote of thanks was tendered to the press, Street Railway Company, Hamilton Cataract Power Company and the Hamilton Association, the convention closed.

AN UP-TO-DATE ENGINE AND THE RESULT.

How many men, whether interested in steam or not, will pass an up-to-date, clean, bright, shiny engine room without remarking to themselves, "That engineer takes pride in the way things look." It does not take an experienced eye to judge the principles employed by the engineer.

The clean floors, the bright walls, the shiny oil can, the rack in the corner with a row of bright tools, the clean steam gauge, all go at a glance, says Dr. Kinkaid, the president of the well-known International Boiler Company, to show the success of the engineer. Some engineers may possibly think the the heads of the firm do not notice the engine room, or do not care—possibly some do not, but the precentage is very small and the chances of the engineer's advancemement are smaller yet.

The engineer who takes an interest in his engine room has in most cases the full say regarding the steam power. He orders the necessary supplies, the boiler compound, the oils, etc., in fact, all that he needs without taking it up with the firm, while the engineer who takes less interest has as a consequence less privileges, and in a good many cases is working only for six o'clock, regardless of the conditions under which he runs his engine. He shuts down every 20 days or so to clean out his boilers, and painfully hammers off the scale.

The engineer with the interest of the firm at stake uses a boiler compound that softens the water, burns less fuel, and saves the time and the expense of shutting down to clean the boilers.

There is a booklet published by the International Boiler Compound Company that every engineer will find well worth sending for. It contains some practical points about keeping boilers clean.

C. Hetherington, of Galt, Ont., has invented a rotary compound engine.

PITTSBURGH TRANSFORMERS.

The Pittsburgh Transformer Company, in their advertsement in this issue, show some excellent illustrations of their power transformers. It is some time since we have illustrated apparatus of this kind, and the engravings in question will doubtless be of interest to everybody engaged in power transmission.

The transformer case proper is composed of a fluted sheet steel tank, which is mounted in a cast iron base and top, these being held together by means of heavy eye bolts. A feature of this construction is that by the removal of these two eye bolts, the top casting may be removed and the tank lifted from the cast iron base, in much the same manner that a cup would be lifted from a saucer, thus permitting easy handling in case repairs to the tank are necessary, such as might be caused by damage to the tank, resulting from rough handling or accidental collision, which might spring the metal and cause leakage.

The tanks are made of No. 20 gauge sheet steel, and are thus exceedingly rigid and will stand a surprising amount of rough handling. The company state that the tanks shown in this issue may be laid upon their sides and as many men stand upon them as can find foot-hold, without the slightest distortion of the circular shape of the tanks, thus showing their extreme rigidity. The hand-hole cover has a diameter of twelve inches in the clear, thus permitting thorough inspection of the interior of the case and easy replenishing of the oil.

The high voltage transformers in this class are equipped with heavy porcelain bushings, thus bringing the high tension cables well above the castings. These bushings extend into the tank, and underneath the surface of the oil, which thus eliminates one of the troubles inherent with high tension transformer leads.

The transformers themselves are of the shell type construction with the coils mounted vertically. There is an oil space between each pair of coils, and between the coils and the iron so that there is a steady flow of cool oil from the bottom to the top through the body of the transformer. The transformer laminations are held between top and bottom plates, the bottom plate having four legs, which support the transformer. This construction has resulted in eliminating uneven temperature rise, which has hitherto been one of the serious objections to shell type transformers.

The company state that the only way in which the operation of a shell type winding, which is embedded in the iron, can be kept cool, is to open the windings so that the oil may flow through in unimpeded currents. The vertical mounting is also essential in order that a good draught may be secured in much the same manner as a draught in a chimney, owing to the difference in temperature between the oil in the top of the transformer tank and that near the bottom.

VISIT TO POWER GLEN.

The president, general manager and directors of the Hamilton Cataract Power, Light & Traction Company recently took a party of one hundred people to Power Glen to inspect the power house and works of the company. A general inspection was made of the old and new plant of the company, and great interest was shown in the vast enterprises now being brought to completion and by which the company will be in a position to supply Hamilton and St. Catharines with all the power required for many years to come. When the work is completed the company will have a chain of artificial lakes about three miles long and from 300 feet to half a mile wide.

An excellent luncheon was served on the property at Power Glen. Hon. Mr. Gibson presided and acted as toast-master.

FIRST-CLASS IN EVERY RESPECT.

Mr. R. S. Cotton, Peterboro, Ont., in remitting his subscription to the ELECTRICAL NEWS, writes: "Your paper is a first-class journal in every respect, and I would not be without it."

A successful test of peat fuel was made on the night of August the 4th in the furnace of the Electric Car Company's station at Yarmouth, N.S. This coke had been perfected largely through the agency of Malcolm Booth, and in the test made demonstrated its intense heat giving powers. Ten minutes after the first supply was put in the furnace the drafts had to be closed, and for several hours the pressure was maintained a 100 lbs. The heat was intense, the peat burning with a clear flame and giving out almost no smoke, while the coke practically burnt away to fine ashes.

CANADIAN ELECTRICAL NEWS TECHNICAL SCHOOL

The announcement of the establishment of our "Technical School" has been received in a manner which leads us to believe that this new feature will be found both interesting and useful to many of the readers of the journal, and now that a start has been made and the holiday season is about closed, we hope that a good many more will join us.

We give below answers or notes on the answers of the questions of last month, and also a new set of questions for this month. As answers for a good many of our questions we shall merely give notes calling attention to the more important features, though we shall be glad to explain difficulties to the best of our ability when asked to do so.

ANSWERS TO AUGUST QUESTIONS.

T1. Anything does work in transferring energy to anything else. (For "anything" consider engine, motor, turbine, water, steam, piston, electric current, etc.)

Power is a rate, the rate at which work is done.

T2. "i.h.p." Indicated horse power. So called because the indicator card is used in its calculation.

"b.h.p." Brake h. p. Horse power wherever it might be measured by a brake (such as the Prony).

T3. For the production of E. M. F. in a generator we must have a magnetic field and conductors cutting that field. The E.M.F. in each conductor is proportional to its rate of cutting magnetic lines—that is to the magnitude of the field and to its rate of cutting the field. The E.M.F. at the terminals or brushes (and this is true for A.C. or D.C.) will be proportional as well therefore to the number of these conductors in series between such terminals or brushes.

P1. $\frac{100}{88} \times \frac{100}{92} \times \frac{100}{98} \times 27 = 34$ lbs. steam per h. p. hour at pump, when motor driven, as compared with 55 lbs. steam per h. p. hour at pump when steam driven. The coal used will be in the same proportion if we assume steam produced with the same efficiency in both cases, and the pumps themselves working at the same efficiency.

P2. Some causes of hot bearings are:—

1. Poor or insufficient oil.
2. Grit or foreign substances in oil, etc.
3. Too tight fit.
4. Bad alignment.
5. Overloaded.
6. Too tight belt.
7. Oil grooves stopped up.
8. Worn out oil. (Needing filtering).
9. Oil cups failing to drip.
10. Rings not turning. (In self oiling bearings).
11. Journal not smooth, or truly circular.
12. Errors in materials or construction of bearings.
13. Errors in design of bearings.

P3. With the object of providing a suitable service under such conditions as will render a minimum the sum of the interest on outlay, the cost of operating and maintenance, and the depreciation of plant, the following are some of the main points usually to be considered:

1. Nature and amount of domestic lighting.
2. " " " municipal "
3. Nature and amount of power service.
4. Day load. Night load. Peak and minimum loads.
5. Compact or extended territory.
6. Source of power—water, steam, etc.
7. Distance of power-house from centre of distribution.
8. If steam, the facilities for obtaining coal, condensing water, etc.

QUESTIONS.

7. What are the usual forms in which we have to deal with or measure energy?

8. What are the functions of a volt meter, ammeter, wattmeter, ampere-hour meter, integrating wattmeter?

9. What does the steam engine indicator give you and how do you make use of this?

10. A small lake discharges through a waterfall. What power can be obtained from it?

We may add the following particulars affecting the competition referred to last month: Three prizes will be offered each month; the first will be in engineering publications to the value of $5.00, the second in engineering publications to the value of $3.00, and the third a year's subscription to the ELECTRICAL NEWS. In addition three prizes will be offered at the end of the year for the best aggregate standing, these to be of the values of $10.00, $5.00 and $3.00 in engineering publications. Of the monthly prizes, no person receiving one shall be eligible subsequently, during the same year, to receive one of the same or of lower grade; this will not affect the prizes given for aggregate standing. The receivers of these prizes will have the privilege of selecting them from standard lists which we shall be glad to furnish. Prizes may be withheld at any time if the character of the answers received is not considered of sufficiently high standard.

Answers should be as brief as possible. Endeavor to strike the vital points. They should be clearly written, on standard letter paper (8½" x 11"), on one side of the paper only, and should be sent in before the fifth of the month following the publication of the questions. All answers received, however, before the awarding of the prizes will be considered.

We take pleasure in announcing that the first prize for last month has been awarded to Mr. H. A. Easter, of Toronto, and the second prize to Mr. L. O'Connor, of Thorold, Ont.

WIND-POWER ELECTRICITY.

The problem of wind power for electric stations has been studied for several years by Prof. La Cour, in the interest of the Danish Government. To overcome the difficulty of irregular speed, the motor is provided with an intermediate shaft in connection with a balance, and the belt from the windmill is led vertically on the disc of this shaft, the pressure on the latter being regulated by the balance bearing convenient counterweights. Through this device the belt slides on the disc as soon as the load exceeds a given maximum. A wind power plant, supplying about 50 amperes of current at 110 volts, has been in operation about a year at Askov, Denmark, and feeds about 450 incandescent lamps. It has given excellent results, with little attention, calms of several days being bridged over by a reserve of petroleum motors.

NEW INSTRUMENTS OF PRECISION.

Accurate measurements are an absolute necessity in electrical practice. This is particularly true in the commercial branches, where the receipts are determined by the records of service meters upon the consumption circuits. Because of this urgent need for accuracy, switchboard and service meters of a high order have been developed and have come into general use, and their adoption has made necessary the use of instruments of a still higher order by which their accuracy and permanency may be checked. In view of the comparatively small number of standard instruments used as compared with switchboard and service meters, it is perhaps not surprising that the development of the latter has out-stripped that of the former, and that a point has been reached where the instruments to be checked have a greater range and a higher accuracy than those by which their performance is measured. That such a condition does exist is well known by those who have to do with the testing and calibration of electrical meters.

In order to bring the standardization of electrical instruments to a place in keeping with its importance, the Westinghouse Electric & Manufacturing Company has developed a line of instruments of precision which combine the accuracy of the best known standards with the portability and rapid and easy manipulation of the testing instruments now in vogue. The advantages of both types have been retained, with the elimination of those features which detract from their value in general use. Having provided instruments of superior quality, the Westinghouse Electric & Manufacturing Company proposes to secure to purchasers a continuation of their initial accuracy by keeping them in calibration for five years without charge. All the facilities of the Westinghouse Department of Standards are placed at the service of possessors of these instruments of precision so far as may be necessary to keep them accurate. Special shipping cases are provided to minimize the labor of packing and shipping. At any time within the period named customers may ship these instruments to the Westinghouse Department of Standards to be checked, and the work will be done promptly, with no cost to the owners except that of carriage.

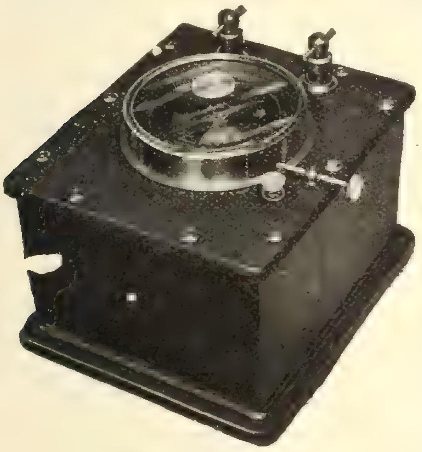


FIG. 1—AMMETER.

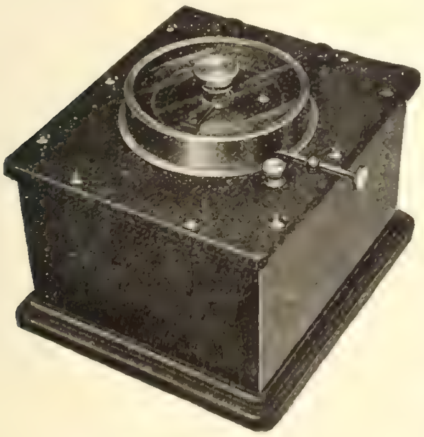


FIG. 2—VOLTMETER.

By first providing instruments which fulfill perfectly the needs of the laboratory and testing room, and by then insuring their continued accuracy, all the present trouble with checking standards is eliminated, and a new system for their care is inaugurated.

The illustrations show the voltmeter, ammeter, wattmeter and the resistance or multiplier used with voltmeter and wattmeter. The cases of the instruments are of polished mahogany, with all exposed parts finely finished. The mechanism is mounted in a cast frame made of a high resistance alloy, and suspended from the top plate. This is made of black enameled slate, giving a rigid construction and not affected by warping or changes in temperature. In principle, these instruments operate on the mutual attraction between two systems of movable and stationary coils arranged in inductive relation to each other, the two systems of coils being so arranged as to neutralize the mutual induction and the effect produced by any external field. The readings are thus equally accurate with direct and alternating currents and there is no necessity for reversing the readings on direct currents as with ordinary standards.

The controlling force is very large, rendering negligible any friction effects, and preventing in this respect a strong contrast to the ordinary standards, in some of which the controlling force is so slight that the static attraction produced by rubbing the glass over the dial will introduce an error.

The scale is accurately graduated upon a five-inch circle, all the divisions being uniform and thus equally legible over the entire range. By means of the vernier, tenths of a division may be read, giving a range of 2,000 readable divisions, greatly exceeding, it is claimed, the readable range of any other standard instrument in general use.

When current passes through the instrument, the sight wire is carried to the right of zero. By means of the large central knob the vernier is turned to the left until the sight wire is approximately upon zero, a fine adjustment being obtained by the knob upon the right.

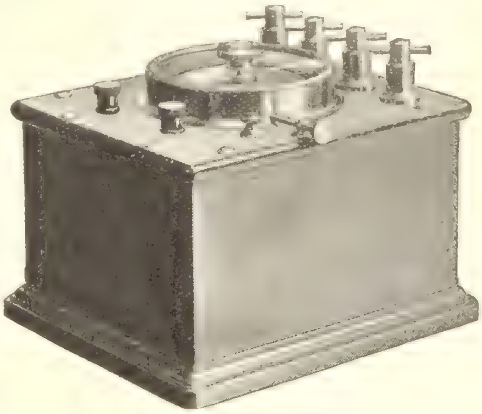


FIG. 3—WATTMETER.

In the voltmeter and ammeter dials the inner graduations are so spaced that their value is proportional to the square root of the deflection, allowing readings to be taken direct, without calculation. When readings of fractional parts of divisions are required, the outside scale with the vernier may be used and the corresponding value of the reading on the inner scale determined from the table of square roots furnished with each instrument. In the wattmeter there is but one set of graduations.

The resistance or multiplier is used in the potential circuit of the voltmeter and wattmeter. The potential coils of the instruments are adjusted to a uniform resistance of 100 ohms, and the external resistance is subdivided so as to give total values of 1,000 ohms or multiples thereof. When in use a resistance of 1,000 ohms is employed for each 100 volts nominal potential. The resistances are accurately checked, and thus form standards of resistance as well as measuring instruments. As the same values are used for both voltmeter and wattmeter, one resistance will answer for both instruments.

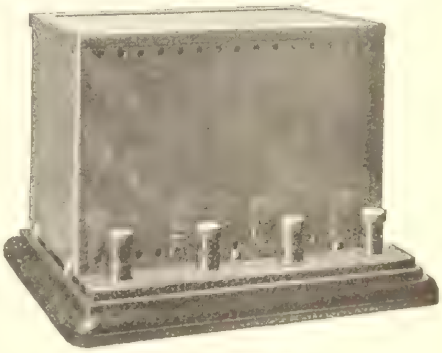


FIG. 4—RESISTANCE.

The facilities afforded for accurate observation are worthy of special mention, and perhaps can be best appreciated by comparison with the instruments now in general use by comparing the fineness of the sight wire with the width of the pointer in the ordinary standard instruments ; the narrow, even, machine-cut division lines of the scale with the hand-drawn irregular lines of other instruments ; and the open divisions of uniform length giving equal legibility at all points, with other scales, the end divisions of which are little if any wider than the lines which divide them or the pointer that indicates the reading. This superiority, which is readily apparent, extends as well to other parts of the instruments, and to the design upon which they are constructed. They are in every way fitted for the checking of electrical metering devices and the accurate measurement of electrical quantities, while the free calibration insures the perpetuation of their accuracy.

PUBLICATIONS.

The Winnipeg Street Railway Company have issued a souvenir of Winnipeg entitled "Where and How to Go."

The Canadian Westinghouse Company, Hamilton, Ont., have issued circular No. 1,057, which contains much information about O.D. transformers. The high efficiency of these transformers make them particularly desirable where power is costly and the question of economy is a prime consideration.

A very attractive booklet has been prepared by the Westinghouse Companies' Publishing Department. It is entitled "Westinghouse Industries as Exemplified at the Louisiana Purchase Exposition at St. Louis." One of the illustrations shows the main service plant, which includes four 2,000 kilowatt Westinghouse generators.

The Edison Electric Illuminating Company, of Brooklyn, have favored us with a copy of the August number of their publication "The Brooklyn Edison," which is devoted to the illustration features at Coney Island. The Dreamland Tower is probably the most artistic example of decorative and spectacular lighting ever produced. This publication will be greatly appreciated by persons interested in illuminating effects.

"The Book of Four Powers" is the title given to what is one of the most attractive catalogues which has yet come to our notice. The publishers are the Allis-Chalmers Bullock Company, machinery manufacturers, the four powers referred to being steam, water, gas and electricity. Among the many excellent illustrations is one showing the belted type Bullock alternators in the power house of the Jacques Cartier Electric Company at Quebec.

The Penberthy Injector Company, of Windsor, Ont., in a new catalogue devoted largely to their well-known injectors, call attention also to several new lines which they are now manufacturing, including "Simco" quick stop boilers, "Salute" flushing signal boilers, "Sultan" back pressure gas engine oilers, "Penberthy" plain engine and force feed double ratchet lubricators, radiator air valves, air cocks and cylinder cocks. Persons who use such apparatus will find much to interest them in this catalogue, No. 21.

The Pittsburgh Transformer Company send us their usual monthly calendar for September. This issue is by far the handsomest thing the company has yet published, and this is saying considerable, for their calendars heretofore have each one seemed to be more artistic than the last. The company advise that these have been mailed to every electric light station and every electrical engineer in Canada whose name appears on their Canadian mailing list, and wish to announce that if anybody has been overlooked or if copies have failed to reach their destination, they will be pleased to send duplicates and add new names to their mailing list.

At the request of the Bureau of Statistics of Labor and Industries of the State of New Jersey, the Weston Electrical Instrument Company, of Newark, N.J., have prepared a pamphlet regarding the Weston Employees' Club. This pamphlet, intended for the Louisiana Purchase Exposition, describes at length the interesting social features connected with the organization and administration of the Weston Electrical Instrument Company. Before planning their new works, the company employed an expert to travel through the country for a year to learn what American employers were doing for their employees outside the mere question of wages, and when the present plant was erected the company reserved the most desirable portions of the premises for social and recreation rooms, dining room, gymnasium, bicycle depot, etc. The inauguration ceremonies took place on May 22nd, 1903. The illustrations in the pamphlet show that every provision has been made for the entertainment and comfort of the employees. Not the least interesting chapter of the pamphlet is that entitled "A Glimpse at the Manufacturing Department," in which a brief description is given of the large works for manufacturing Weston instruments.

The Central Telephone Company have purchased the St. Martin's telephone system at St. Martin's, N.B., and are now erecting an extension through part of King's County. The company have 110 instruments in Woodstock and 400 miles of wires connecting Florenceville, Centreville, Grand Forks and other places.

TRADE NOTES.

The Pearson Manufacturing Company, of Brighton, Eng., write that they are desirous of securing Canadian agents for their electrolytic meters, and will be pleased to send descriptive catalogue on application from Canadian firms.

The Hillcoat Bearing Company, Limited, has been incorporated, with a capital of $20,000, to manufacture ball and roller bearings. The head office is at Amherst, N. S., Mr. John W. Taylor, manufacturer, of that town, being one of the promoters.

The Whaley Automatic Smoke Preventer & Fuel Saver, Limited, has been incorporated at Toronto, with a capital of $25,000. The provisional directors of the company are Messrs. John T. Eastwood, broker ; N. W. Tovell and Frank Hodson, accountants ; E. E. Wallace, barrister, and J. H. Hallett, druggist.

The Allis-Chalmers-Bullock-Company, Limited, through their Winnipeg office, have secured the contract for supplying the electrical driven pump for the new waterworks system at Lethbridge, N. W. T. This company have recently opened a branch office in the British North American Building, Winnipeg, with Mr. L. J. Belnap as district manager.

The Rossendale Belting Company, 59-63 Front Street East, Toronto, have secured from the Vancouver Portland Cement Company, of Vancouver, B. C., an order for 3,000 feet of "M. A. Y." Rossendale belting, ranging in width from 4 inches to 60 inches, including single, double and triple strength belting, also 4-ply carrying belts and belt fasteners. The order will be shipped from the factory in Manchester, Eng,, direct to Vancouver, and is intended for new cement works to be built at Saanich Arm.

The Packard Electric Company, Limited, have recently reorganized and enlarged their sales department, which has become necessary in order to successful handle their rapidly increasing business. Mr. George C. Rough, who has been manager of the eastern office in Montreal, has been appointed manager of the sales department at the head office in St. Catharines, and is succeeded by Mr. Cecil Doutre, who is well and favorably known to the electrical trade, and who will hereafter look after the interests of the company in the east. The services of Mr. J. H. Leamy, late with the Westinghouse Company, have been secured, and he will cover the Ontario district, while Mr. George A. Powell will continue to look after the important western territory, as manager of the western office in Winnipeg. Mr. E. R. Grimshaw will be connected with the office end of the sales department at St. Catharines.

SPARKS.

Plans have been completed for the proposed extension to the Bell Telephone Company's buildings in Winnipeg. The plans call for a $50,000 building, which will enclose the old one on two sides, and will nearly treble the present office capacity. The top floor will contain a 20,000 multiple switch, now under construction.

The "central energy" system of telephony has recently been installed in the towns of New Glasgow, Westville, Stellarton, and Trenton, N.S. It is intended to increase the rates $5 a year, making house telephones $25 and business telephones $30, but this increase cannot be made without the sanction of the Provincial Government.

The office of assistant chief electrical engineer for the western lines of the Canadian Pacific Railway is to be created shortly, and Mr. H. H. Boyd, of Montreal, is said to be slated for the position. The headquarters for the new office will be at Winnipeg. The appointment is significant of the broad scheme that the company has in mind for the development of electrical power, wherever practicable, throughout the west.

Arrangements are practically completed for the installation, by the New Westminster and Burrard Inlet Telephone Company, of New Westminster, and the International Telephone Company, of Bellingham, Wash., of a telephone cable line to connect Bellingham and Vancouver by a direct wire. It will be constructed partially by American and partially by Canadian capital. The proposed route of the cable is from the eastern shore of Vancouver Island, across San Juan, Orcasm, Shaw and Lummi Islands. The entire line will be some 65 miles in length, 15 of which will be sea cable. The cable will be of English make and will consist of four copper wires.

SPARKS.

A by-law to loan $15,000 to the Ontario Electric Railway Company was carried at Colborne, Ont., recently.

A new company has made an offer to light the town of Calgary, N.W.T., furnishing 85 lights of 1,200 candle power each at $85 per lamp per year, providing a contract is given for sixteen years.

The syndicate known as the "Dam Syndicate," which own water rights at Victoria Lake, on the River Avon, have offered their rights to the city of Stratford, Ont., for $10,000. The property produces a revenue of $1,000 from lessees.

Mr. R. S. Kelsch, electrical expert, of Montreal, is acting in a supervisory capacity for the Hull and Ottawa Power Company, which is installing a new 2,000 h.p. generator, water wheels, and switchboard. The company will furnish power to the International Portland Cement Company to the maximum amount of 3,000 horse power.

The Ogilvie Flour Mills Company have made an arrangement with the town of Fort William, Ont., for electric power to operate their new elevator. The company will take the power they require during the day at 10 per cent. above the cost of production, and will pay $50 per horse power per year for whatever surplus power can be obtained at night.

The Town Council of Sarnia, Ont., have offered $50,000 for the electric and gas plants in that town.

Forest fires burned down the pole line of the West Kootenay Power & Light Company at a point between Nelson and Bonnington Falls, B.C.

Mr. Fred J. Marshall, City Electrician of Kamloops, B. C., has tendered his resignation and has accepted a position with the Canadian General Electric Company, of Vancouver.

The General Electric Company, of Schenectady, N. Y., have shut down their mica works at Smith's Falls and Perth, Ont., and have reduced the staff at the Ottawa works to sixty.

The second annual picnic of the Quebec Railway, Light & Power Company took place on August 18th at Cap Tourment and was attended by half of the employees and their friends. The second division held their outing on August 24.

Mr. Joseph Battle is making satisfactory progress on his contract for the construction of a stone and timber dam for the Orillia power plant. The contract price is $28,000 and the work is to be completed by October 25th under a penalty of $25 a day.

The City Council of London, Ont., have granted the Bell Telephone Company an exclusive franchise for three years from January 1st last, at a yearly rental of $2,500, being an increase of $1,500 per annum over the expiring franchise; rates to remain as at present.

The Anglo-American Cable Company have decided to reduce the telegraphic rates from Prince Edward Island to the main land. This decision may have been influenced by the announcement of the Dominion Government's intention to establish the Marconi system.

The Pacific Coast Wood Pulp & Power Company, with head offices in London, Eng., have absorbed the Pacific Coast Power Company and the Industrial Power Company, both of Vancouver, B. C., and are now actively engaged in floating the concern. It is proposed to construct pulp mills on the Powell river, about eighty miles north of Vancouver.

Mr. G. A. Powell, of the Packard Electric Company, has just returned to the company's office in Winnipeg from a journey through the Northwest Territories. He reports business in excellent shape, and the prospects very promising. The advancement of the Western Cities is most marked and the prevailing disposition is to at once establish things on a modern basis.

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SPARKS.

The City Council of Waterloo, Ont., is still negotiating for the purchase of the electric light plant.

Mr. Philip Lahee, of Montreal, has secured the contract for the installation of an electric plant for the new C.P.R. hotel and depot at Winnipeg.

The ratepayers of Chilliwack, B.C., have agreed to grant certain privileges to the Chilliwack Light & Power Company, represented by Mr. B. Morgan. The company will install an electric plant, utilizing the water power of Vedder creek, and in addition to supplying electric light and power will operate an electric railway to be built connecting Chilliwack and New Westminster.

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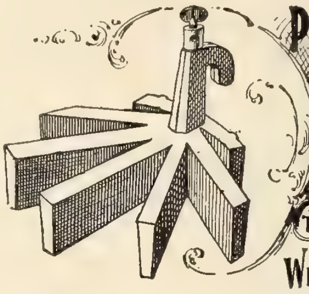

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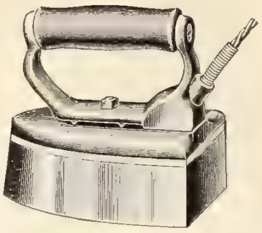

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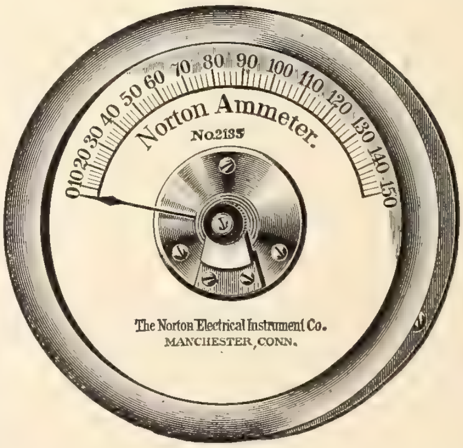
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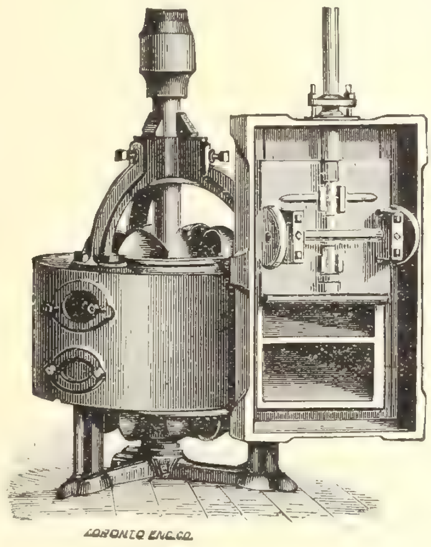

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SPARKS.

The International Telephone Company are installing a telephone system at Fort Frances, Ont.

The Great North-Western Telegraph Company are about to commence the erection of a new building in Quebec.

The Co-Operative Telephone Company, of Detroit, are endeavoring to secure a telephone franchise in Windsor, Ont.

The Bell Telephone Company's call book recently issued shows that Montreal has 14,700 telephones, the largest number of any city in Canada. Within the last year the number increased over one thousand.

The Rainy River International Telephone Company have secured a franchise at Rainy River, Ont., and will install a plant at once. There will be long distance connections with Beaudette, Fort Frances and International Falls. A local company has also applied to the Town Council for a franchise to install an electric light system in that town.

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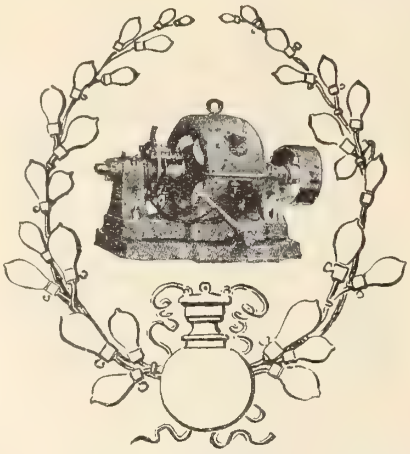

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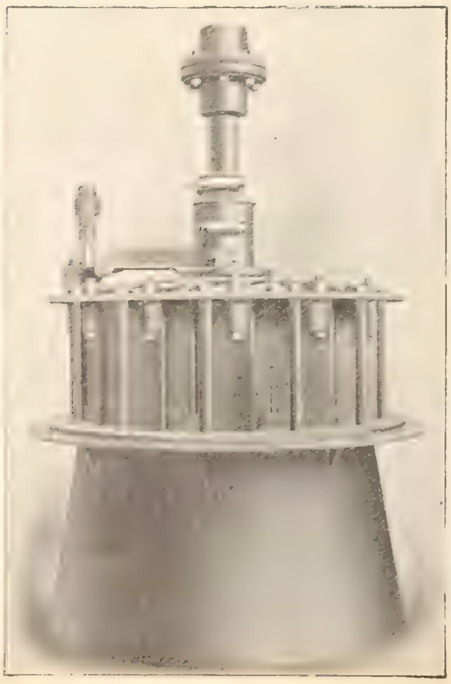

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SPARKS.

The St. John Street Railway Company have found that, notwithstanding the new generators which theo recently installed, their plant is not capable of handling the load at all times, and it has been decided to install another large generator for incandescent lighting.

The Grand Trunk Railway are said to have finally decided upon plans for substituting electric power for operating the trains through the Sarnia tunnel. The plans call for the three-rail system and the cost is estimated at $400,000. It is calculated that the saving effected by the adoption of electricity will be about $40,000 a year. It is probable the substitution of electric power for the present method, with its smoke and coal gases, will make the Grand Trunk much more popular with the travelling public. The tunnel will be lighted up as bright as day, permitting passengers to see the whole interior when passing through.

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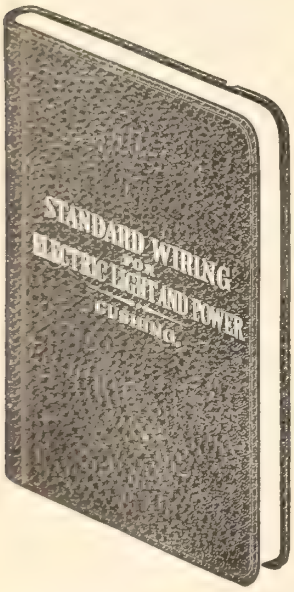

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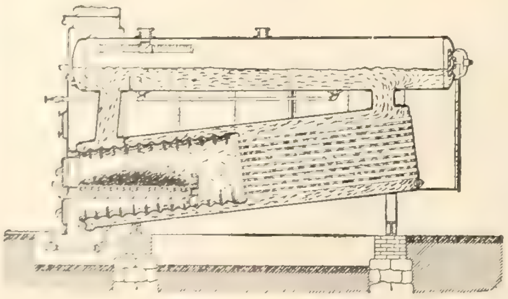

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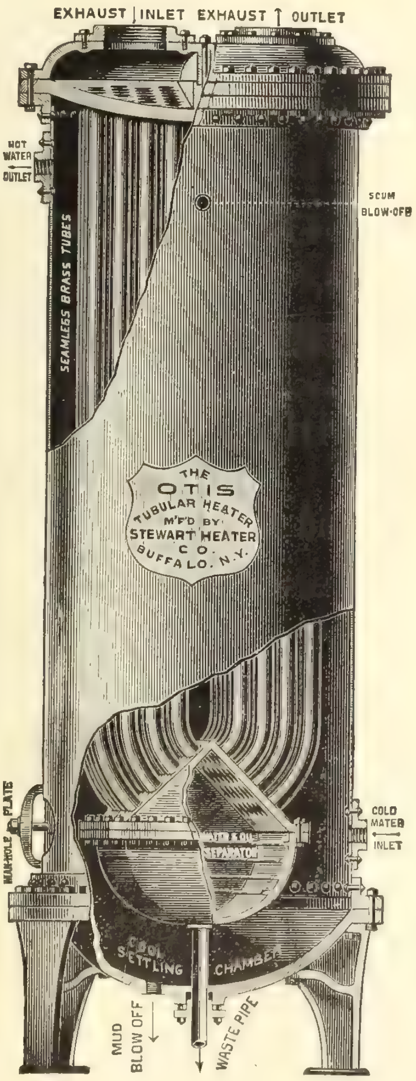

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SPARKS.

The Dominion Government has made an agreement with the Submarine Signal Company, of Boston, for the installation of thirty bells in the St. Lawrence and off the coast of the Maritime Provinces, 26 stations to be operated from shore, and four from lightships. Arrangements are being made for the placing of telephone receiving apparatus on ships making Canadian ports. The wires on the ships will pick up sounds from bells at distances ranging from four to ten miles, and it is said that there is no difficulty in determining the directions of the sounds.

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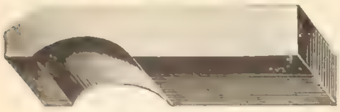

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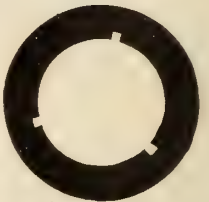

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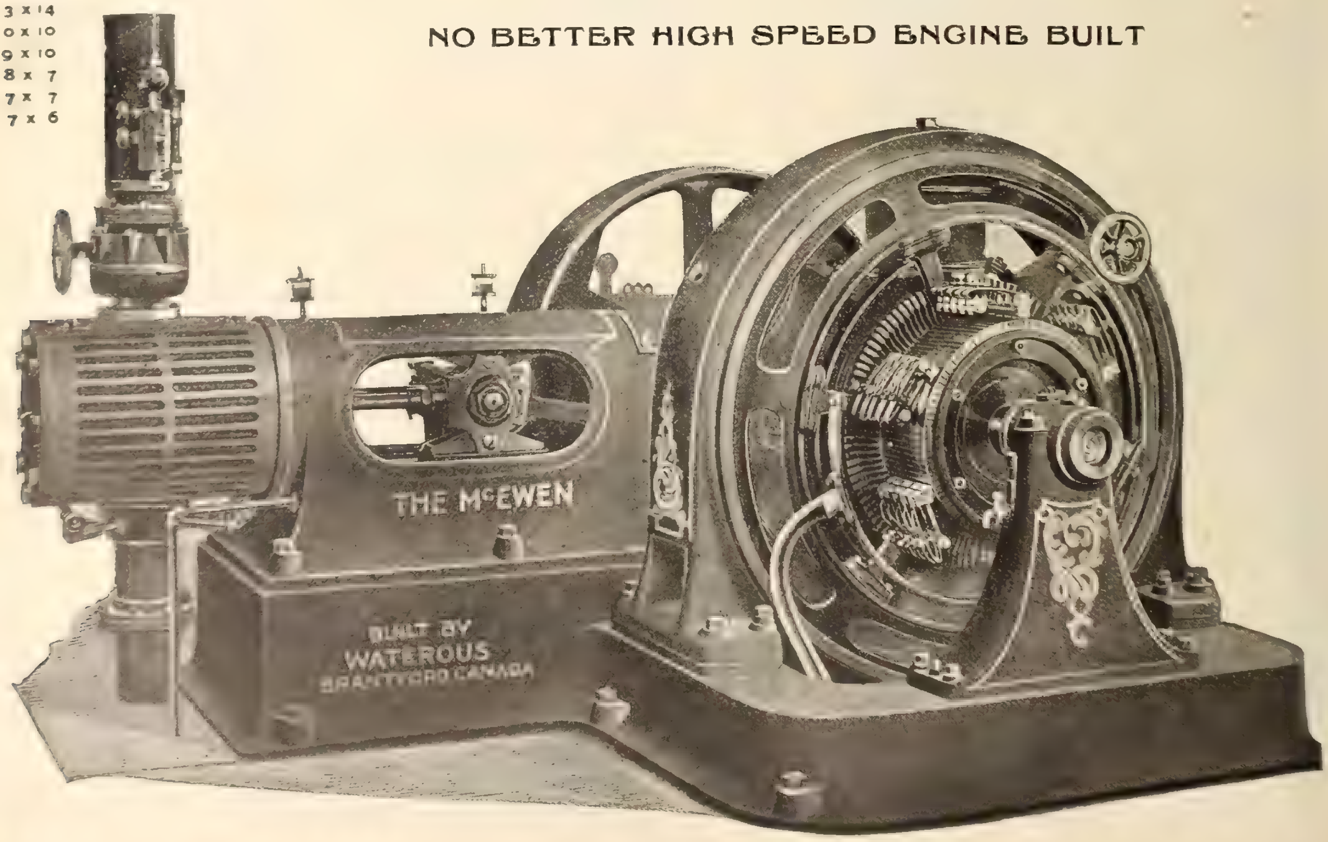

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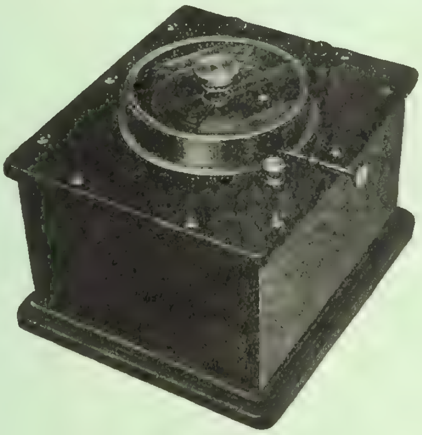

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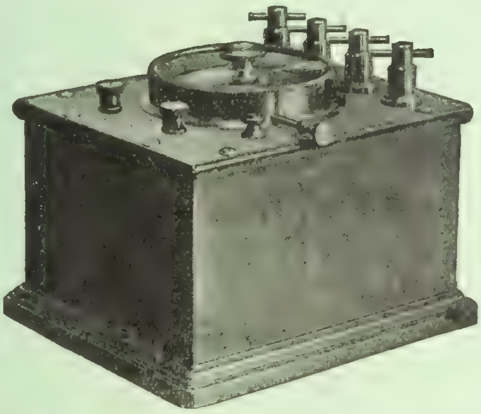

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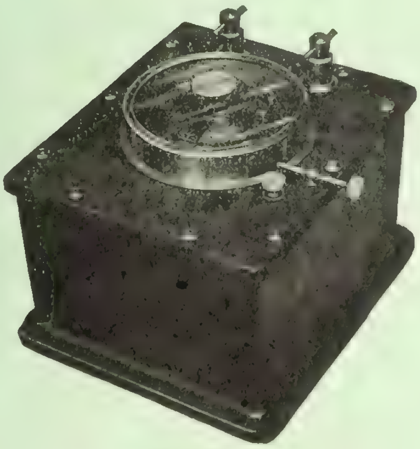

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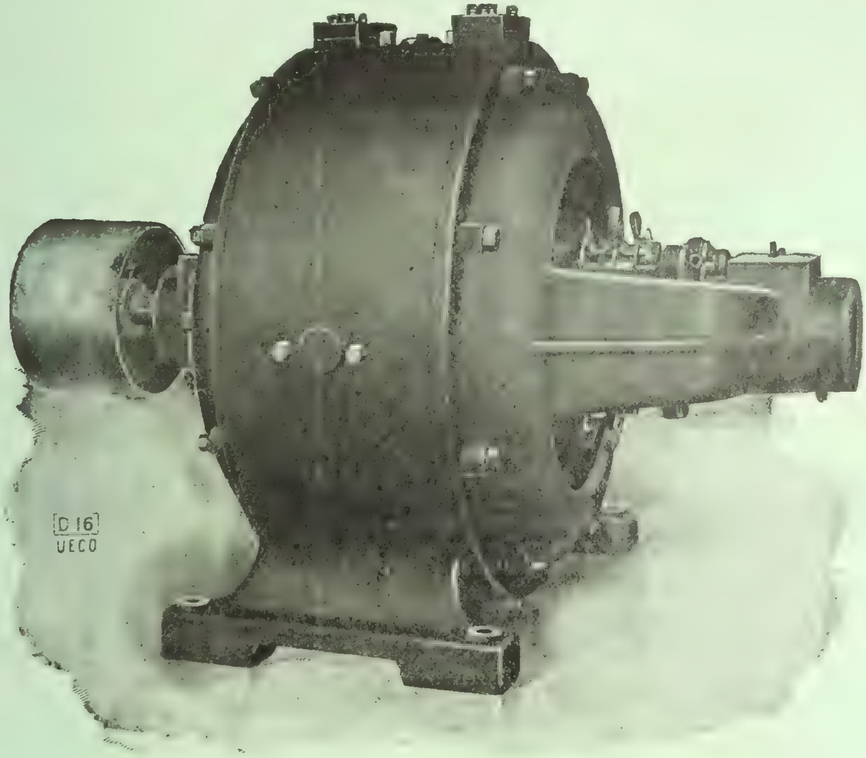

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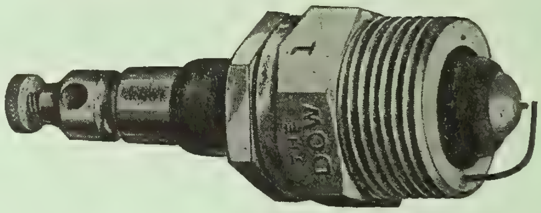

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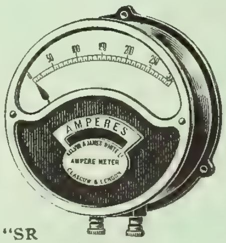

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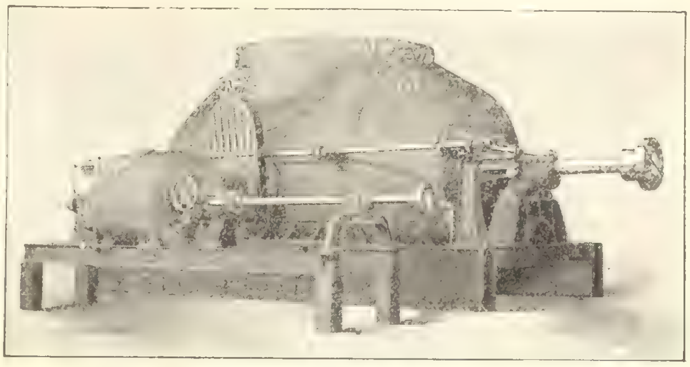

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SPARKS.

Since the Corporation of Berlin, Ont., acquired the electric plant at that place about two years ago, the power for operating the Berlin and Waterloo street railway and the Bridgeport line has been purchased from the town, but Mr. Breithaupt recently decided to build a new power house for the operation of the railways. This is now in course of construction and is located at the Berlin terminus of the line. The initial installation will be 230 horse power and will include a 150 k.w. Westinghouse dynamo. Repair shops are also being built.

Hon. Charles D. Haines, a large railway contractor of New York, recently addressed the Wentworth County Council at Hamilton regarding a proposal to construct an electric railway from Hamilton to Brantford by way of Ancaster. Mr. Haines went over the proposed route with Mr. Leslie, of Toronto, who is said to hold the charter, which will expire at the end of October unless the work of construction is begun before that date. The promoters asked for a right of way over small sections of country roads where private right of way cannot be obtained.

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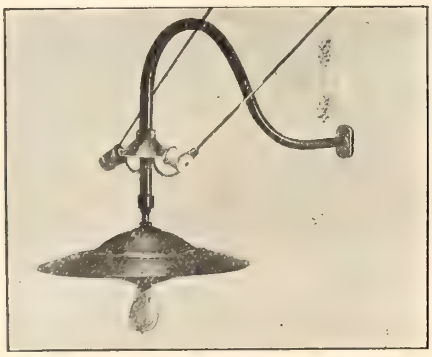

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SPARKS.

The Coaticook Electric Light Company, of Coaticook, Que., recently reconstructed their dam.

Plans are being formulated for the construction of an electric railway between Agassiz and Lake Harrison, B. C.

The Gilmour Door Company, Trenton, Ont., are about to remodel and increase their power plant and have taken estimates on new boilers, generators, etc.

A company is reported to have acquired the rights to the water power of the Gaspereau river in Nova Scotia, with the idea of furnishing electric light and power throughout the Annapolis Valley.

John Herne, employed by the Lakefield Portland Cement Company at Lakefield, Ont., was instantly killed while working on the roof of the building by accidentally coming in contact with a live electric wire.

Electricity will be employed for operating the new shops of the Grand Trunk Railway now under construction at Stratford, Ont. The new boiler shop will be 169 × 120 feet and will be equipped with two electric travelling cranes.

The Shawinigan Water & Power Company, of Shawinigan Falls, Que., have given a contract to the Canadian Westinghouse Company for a two-phase rotating field alternator of 6,600 k.w. capacity and 2,200 kilowatts in transformers.

The proposition of the Chilliwack Light and Power Company has been endorsed by the ratepayers of Chilliwack, B.C., and as a result that place will be lighted by electricity in the near future. The company's franchise is exclusive for twenty-five years, covering the sale of power and the lighting of the city. Mr. Robert Maitland is engineer for the company.

Mr. P. Herault, of La Pras, France, who has made a study of the process of making steel by electricity, was in Ottawa last month looking into the possibilities for a plant in that vicinity. The essentials for this industry, cheap electrical energy and an abundance of magnetic iron ore, are to be found near Ottawa, and it is thought that works may be established at no distant date.

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With Hollow or Solid Terminals—Applied With Steel Drift Pin or Screw Compressor.
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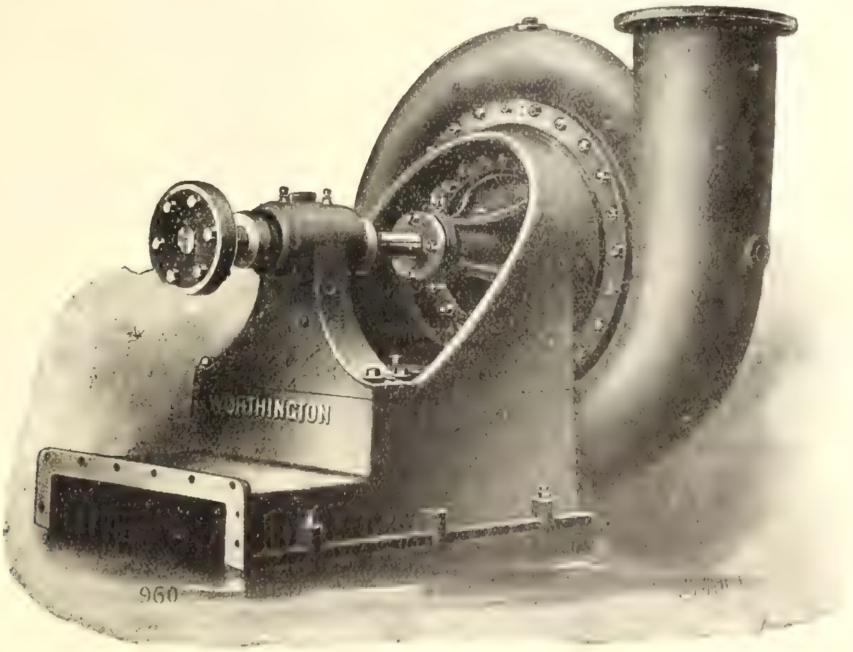

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MOONLIGHT SCHEDULE FOR NOVEMBER.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Nov. 1	5 20	Nov. 2	2 00	8 40
2	5 20	3	3 00	9 40
3	5 20	4	4 15	10 55
4	5 20	5	5 30	12 10
5	5 20	6	6 00	12 40
6	5 15	7	6 00	12 45
7	5 15	8	6 00	12 45
8	5 15	9	6 00	12 45
9	5 15	10	6 00	12 45
10	5 15	11	6 00	12 45
11	5 10	12	6 00	12 50
12	5 10	13	6 00	12 50
13	5 10	14	6 15	13 05
14	10 00	15	6 15	8 15
15	10 50	16	6 15	7 25
16	11 45	17	6 15	6 30
18	0 45	18	6 15	5 30
19	1 45	19	6 15	4 30
20	2 40	20	6 15	3 35
21	3 30	21	6 15	2 45
22	No Light	22	No Light	
23	"	23	"	
24	5 00	24	7 50	2 50
25	5 00	25	8 40	3 40
26	5 00	26	9 40	4 40
27	5 00	27	10 45	5 45
28	5 00	28	11 45	6 45
29	5 00	30	1 00	8 00
30	5 00	Dec. 1	2 00	9 00
			Total............	235 45

It is stated that certain capitalists are considering the utilization of the peat bogs near Brockville, Ont., for the generation of electric energy. Messrs. George I. Mallory and W. H. Comstock, of Brockville, are said to be interested.

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We will ship your transformers the day your order gets here, and of course the transformers will be good transformers. They will be billed just as low as such transformers can be billed.

That's about all. But afterwards we shall expect to hear from you pretty regularly.

Pittsburgh Transformer Company,

Pittsburgh, Pa.

Pittsburgh, October, 1904.

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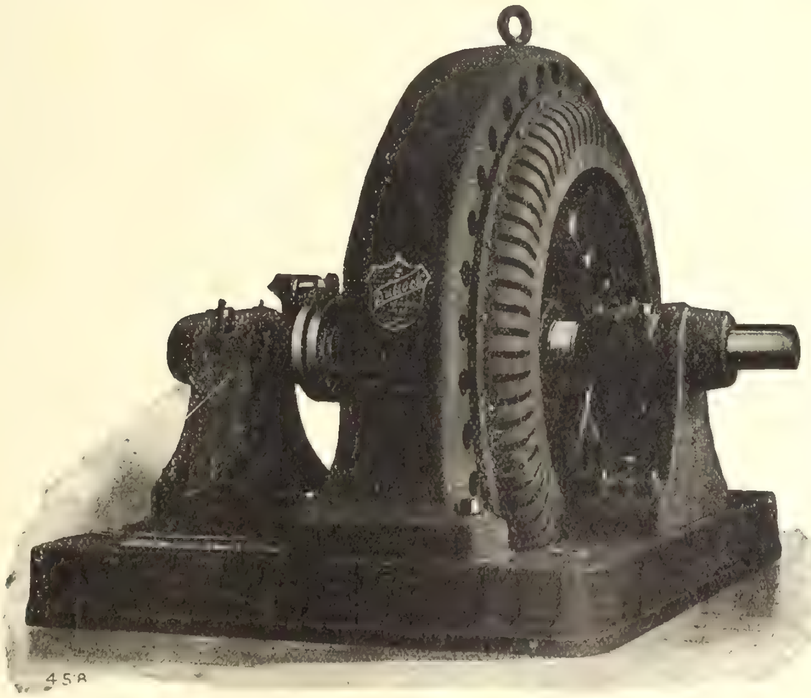

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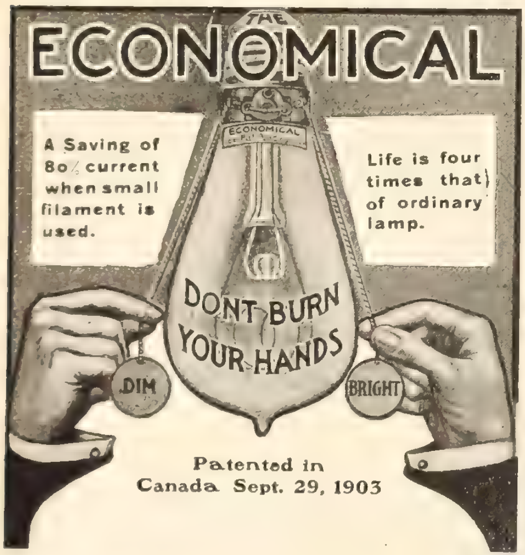
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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIV. OCTOBER, 1904 No. 10.

THE TORONTO RAILWAY STORAGE BATTERY.

In 1891 the Toronto Railway Company took over the Toronto Street Railway's horse-car line and installed an electric plant consisting of nine belt-driven 200 k.w. Edison bi-polar generators. As the system grew the steam generating plant was increased from time to time by the addition of two 800 k.w. and two 850 k.w. direct connected units. Notwithstanding this increase, the plant soon became insufficient for the rapidly growing load and the larger double-truck four-motor equipment cars which the company built to handle the greater traffic.

The load by this time had assumed a high even peak, requiring an average of about 1000 k.w. extra for from one to two hours, according to the season. Besides this increase in the average load, the fluctuations caused by the larger cars and increased traffic were so severe that at times the station equipment became dangerously overloaded. Owing to this condition it was clearly necessary to make some increase in the plant and to have some reserve capacity for incidental overloads and breakdowns.

The successful operation of many storage battery plants in connection with electric railways indicated that such an installation would overcome the difficulties caused by the peaks and fluctuations, and on this account it was decided to install a storage battery to carry a peak of about 1100 k.w. for two hours, and to regulate the fluctuations to the extent of about 2,000 k.w. In addition to this two 850 k.w. direct-connected sets were purchased, so that the steam plant would be complete without the old Edison machines.

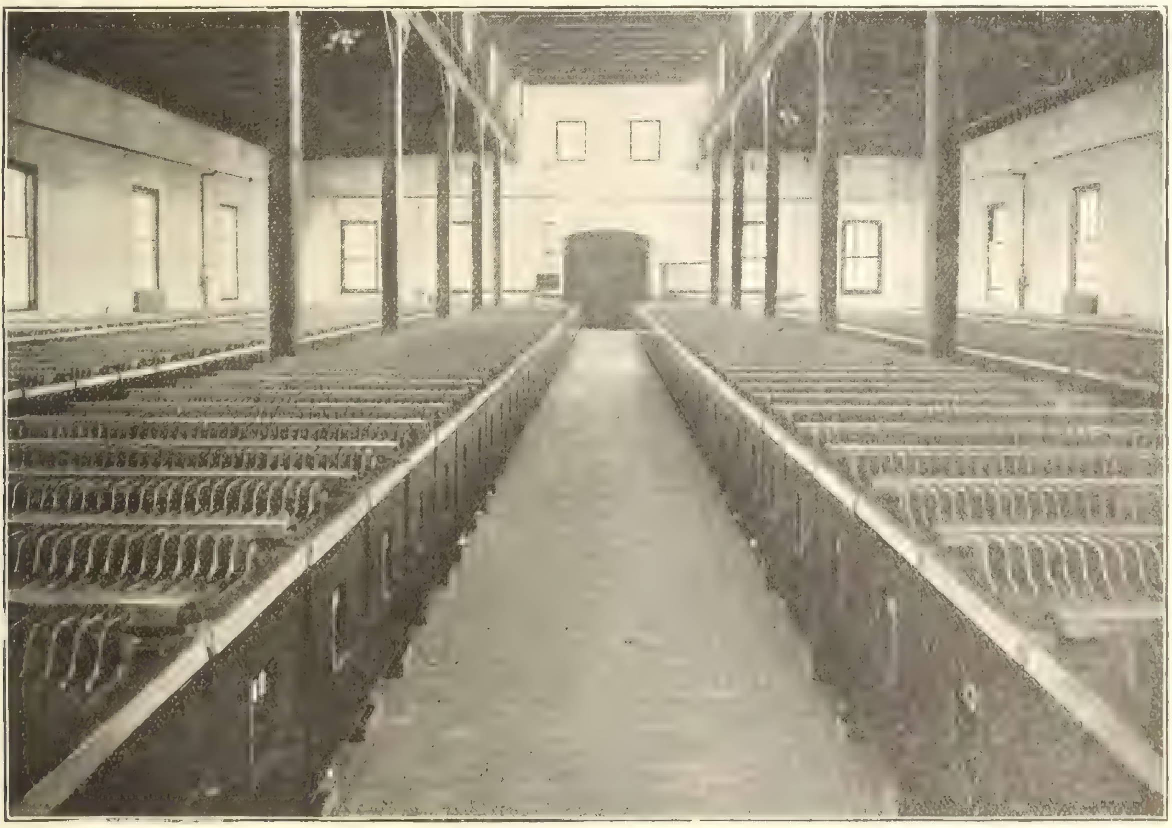

FIG. 1.—INTERIOR OF BATTERY HOUSE, SHOWING METHOD OF INSTALLING THE BATTERY.

As the plant now stands it consists of two 850 k.w. and four 800 k.w. direct connected sets, eight 200 k.w. Edison bi-polar machines, and a 1,700 k.w. storage battery. The old Edison machines are still in use, as the 800 k.w. machines are undergoing a complete overhauling. When this work is completed the Edison machines will be removed and rotary transformers installed in anticipation of power from Niagara. The storage battery is the well-known "Chloride Accumulator", and consists of 276 cells of type "G" 85 plate elements, in lead-lined wooden tanks.

Fig. 1 shows the interior of the battery house, and the method of installing the battery. The 276 cells are connected together in series, the lugs of the plates being lead-burned to rolled lead bus-bars, thus insuring solid electrical and mechanical contact. The bus-bars of the terminal cells of each row are reinforced with heavy copper bars, insuring equal discharge from all the plates ; these terminal cells are connected across the aisles as shown in the illustration, the connections being double bars of lead-coated copper 4″ wide by ½″ thick. The positive and negative terminals of the battery are connected to the switchboard by three 1,000,000 C.M. lead-encased cables each. These cables are carried from the battery house under the street through tile conduits.

Fig. 2 —Exterior of Battery House.

The wooden battery tanks, which are thoroughly painted with acid-proof paint, are lined with heavy sheet lead. The edges of the lead sheets are turned over and stand out from the wood a short distance so that any acid which may be splashed out will fall to the floor without dripping on the tanks.

Each tank is set on double-petticoat glass insulators which rest on wooden stringers well painted with acid-proof paint. These stringers rest on double-petticoat porcelain insulators, which in turn are supported by vitrified bricks resting on the floor. This method insures the complete insulation of one cell from another, and of the whole battery from the ground.

Fig. 2 shows the exterior of the battery house, which was specially designed and constructed for the purpose. The roof is of the cupola type, which is an important feature, as the ventilation afforded by the cupola windows carries off the disagreeable fumes arising from the battery, which are so noticeable in most battery houses.

Referring again to Fig. 1, the floor construction is of interest. It is designed not only to carry the enormous weight of the battery, but also to resist the action of the acid. On a deep concrete foundation a layer of soft cement was spread, on which vitrified bricks were set on edge, and the interstices filled with hot pitch. Acid-proof ducts were laid beneath the aisle spaces and openings were left for the drainage of acid or water, the floor being gently sloped towards these openings.

The battery house is heated by steam coils placed at intervals along the walls ; although the cells are not injured by cold weather, it is advisable to keep the temperature at about 70° F. in order to obtain the greatest capacity from the cells.

This battery is capable of discharging at 2,000 amperes for two hours, and at 3,000 amperes when regulating the rapid fluctuations of the circuit. When it is remembered that the normal capacity of one of the 850 k.w. machines is 1,500 amperes, the possession of a reserve capacity of 3,000 amperes ready for instant use will be appreciated. It will also be seen that operation without the battery would require at least one extra

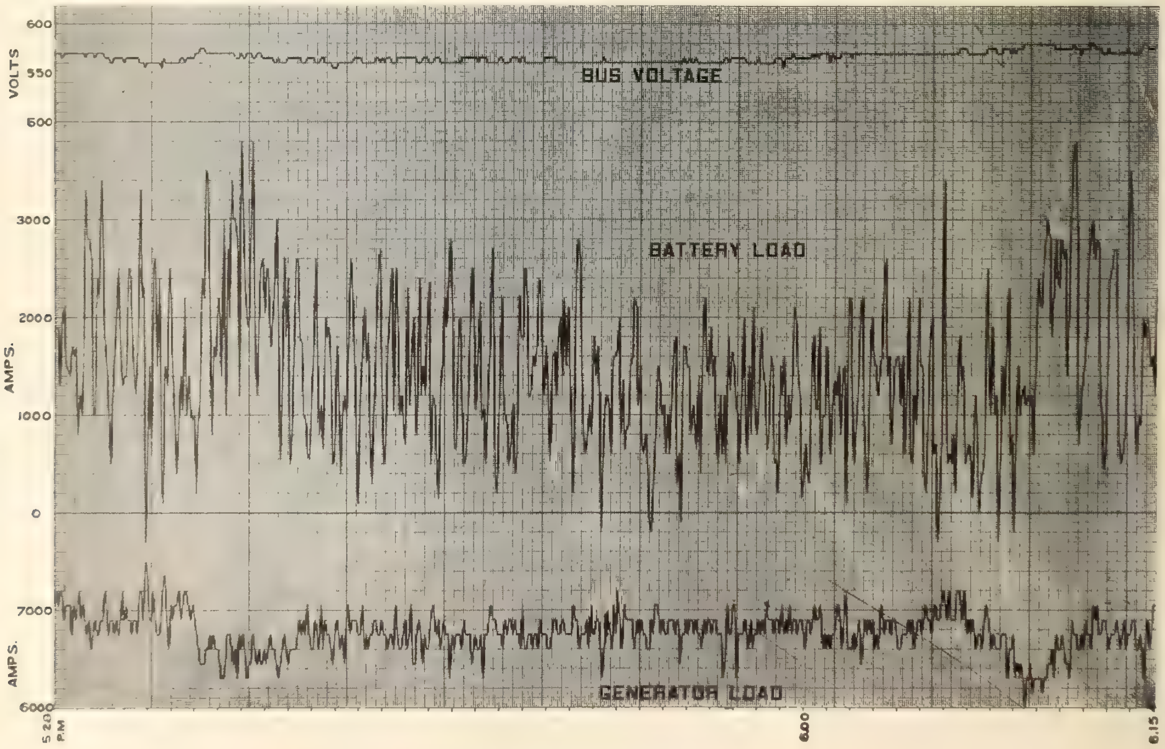

Fig. 3.—Load Curves.

machine to be ready for the fluctuations of from 1,000 to 3,000 amperes which occur so frequently.

Briefly the advantages obtained from the battery are :

(1) Absorbtion of load fluctuations and consequent diminution of wear and tear on the station equipment.

(2) Maintenance of steady load on the generator, with the consequent improvement in load factor and reduction in load consumption.

(3) Extra capacity for carrying peak loads.

(4) Maintainance of steady bus voltage.

(5) Source of reserve in case of breakdowns or other contingencies.

The curves in Fig. 3 illustrate the first four points. These readings were taken during the evening when the battery was both carrying the peak and regulating the fluctuations. The lower curve represents the generator load ; the second curve, the battery load ; and the upper curve, the bus voltage.

A glance is all that is necessary to show clearly the difference between the small fluctuations on the generator load and the large fluctuations on the battery. The former average from 150 to 300 amperes, while the latter vary from 300 amperes charge to 3,800 amperes discharge, or a total range of 4,100 amperes.

As the average load on the generator is about 7,000 amperes, the effect of such small fluctuations as 150 to 300 amperes is not noticeable, whereas before the installation of the battery the fluctuations of 1,000 to 2,000 and even 3,000 amperes caused serious strains on the commutators, and momentary decrease in speed, with the accompanying poor voltage regulation.

The upper curve shows the excellent voltage that is maintained since the installation of the battery.

As the plant is now operated the battery floats on the bus at all times except during the weekly overcharge, and by means of the booster, automatically charges and discharges with the rise and fall in the external load above or below the average generator load.

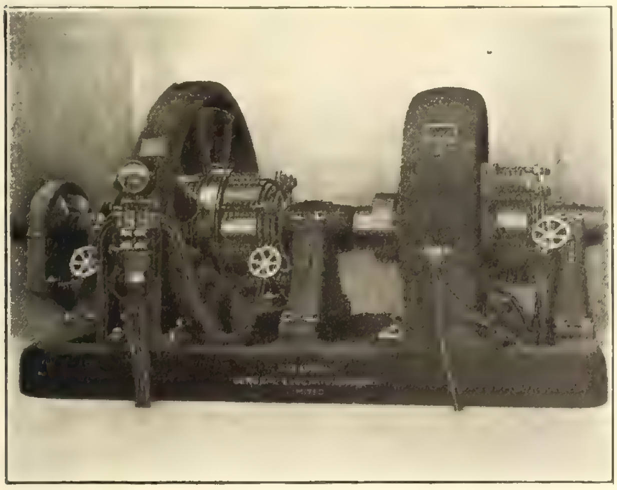

Fig. 4.—Motor Driven Booster ; 350 h. p. Motor on the Right ; Booster Field Exciter on the Extreme Left.

Fig 4. illustrates the motor-driven booster. On the right is the 350 h.p. motor, and on the extreme left, the booster field exciter. This exciter is controlled by a very sensitive piece of apparatus, known as the carbon regulator, which is so designed that the rise or fall of current in the main bus automatically regulates the booster voltage so that the battery discharges or charges as is required.

On account of the large current capacity of the booster, it is supplied with two commutators. In order that these commutators shall bear the load equally, the machine is supplied with a zero centre ammeter mounted on the frame, which enables the attendant to see at a glance whether each commutator is carrying its proper share of the load. The illustration shows the ammeter and the two ammeter shunts, one for each commutator.

Fig. 5 illustrates the battery switchboard which was designed to match the feeder and rotary panels that will eventually be installed on either side.

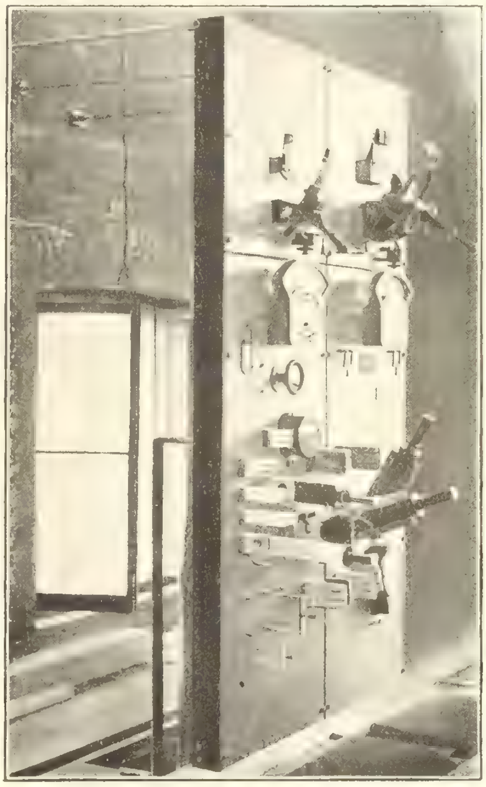

Fig. 5.—Battery Switchboard.

The battery and motor circuit breakers are interlocked to prevent the booster from motoring should the motor circuit breaker open. The booster set is also supplied with a speed limiting device which automatically opens the circuit breakers should the speed exceed a certain point.

On the left of the voltmeter is the four-circuit voltmeter switch, which by the simple placing of the two-point plug, indicates the voltage of the bus, the battery, bus and booster, or battery and booster.

Directly under the rheostat head is the two-way ammeter on the booster field circuit, which indicates the direction and the amount of field excitation. Immediately below this ammeter is a small circuit breaker in the exciter circuit.

The two switches under the main ammeter control the regulator and the exciter field. The two double throw switches on the bottom left-hand panel allow the booster field circuit to be reversed and to be excited either from the bus or exciter. The vacant space under the ammeter will be occupied by the carbon regulator when the remaining panels and machinery are installed.

Although the battery has been in operation for about six months, it has already proved itself indispensable. On many occasions it has been of great assistance in tiding over periods of low steam, and on one occasion when a break-down occurred during the heavy traffic of the annual exhibition, it discharged for a short time at 4,000 amperes until the auxiliary machines were put in operation.

This installation was designed, supplied, and installed under the supervision of the Engineering Staff of the Canadian General Electric Company.

THE LOCOMOTIVE AND MACHINE COMPANY OF MONTREAL, LIMITED.

By John Murphy.

At Longue Point, on the North Shore of the St Lawrence River, about five miles in an easterly direction from the centre of the City of Montreal, are situated the works and property of the Locomotive and Machine Company of Montreal, Limited. The company's property embraces 70 acres of land, and the location is an ideal one for manufacturing puposes. At present communication with the City is afforded by the lines of the Montreal Terminal Railway and of the Montreal Street Railway. In a short time there will also be connection by water, as a dock is in course of construction at which even the largest ocean steamers may discharge or take on cargo. Visitors can reach the works by the Notre Dame or St. Catherine Street cars, or by those of the Montreal Terminal Railway.

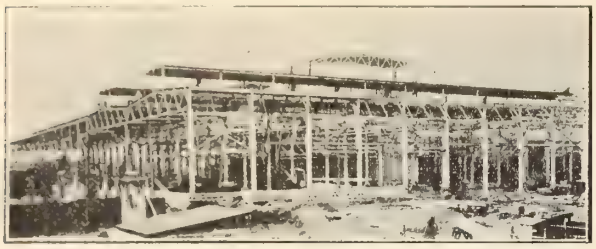

Fig. 1.—Shops in Course of Erection. Steel Fabricated on the Ground by Motor Driven Tools; Motors Supplied with Power from Shawinigan Falls.

The capital stock of the company is $3,000,000. Their shops occupy a floor space of nearly 250,000 square feet and are used solely for the purposes of building locomotives and fabricating structural steel. As now equipped, the shops have a capacity of 250 locomotives per year, and their annual output of structural steel is 12,000 tons. At present their employees number one thousand.

In the opinion of experts the arrangement and equipment of the company's shops are superior to those of any other like industry to be found on either continent. The buildings are of a very substantial character and have all been erected with an eye to future extensions. They contain the most modern tools and labor-saving devices, but, as it is principally because of their electrical equipment that they stand unique, a short description of the latter may prove interesting.

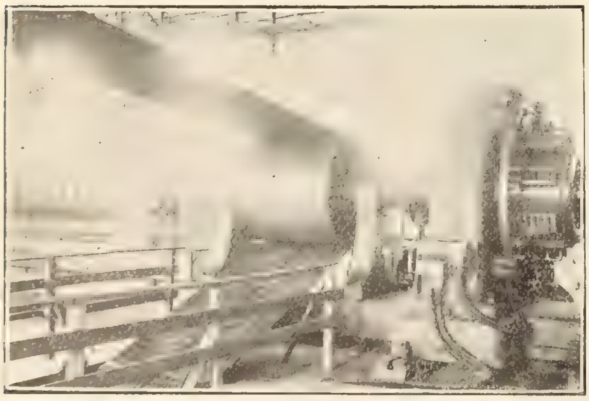

Fig. 2.—Belted Engine-Driven Three-Wire Generator and Switchboard in Power House.

In the company's power house two generators are installed; one is an engine-driven machine with provision for a motor connection it such should be desired; the other generator is motor-driven. Power for the latter is supplied from Shawinigan Falls, 90 miles distant. Both generators were manufactured by the Western Electric Company, and from them continuous or direct current is obtained at 115 and 230 volts. The engine-driven machine is a three-wire or double current generator, but its alternating currrent feature is only used for the purpose of securing current at 115 volts by means of the "balance coils" which are connected to the slip rings on the armature of the generator. Above is a diagrammatic sketch showing the three wire generator with its commutator collector rings and balance coils, as well as a motor which, while having its field coils connected across the circuit from the generator's commutator, may have its armature connected to these same terminals, or to one of them, and to the terminal coming from the centre of the balance coils; by this means 115 or 230 volts may be applied to a motor armature and two speeds obtained. Intermediate speeds and speed in excess of the normal speed at 230 volts are secured by introducing resistance into the motor's field circuit.

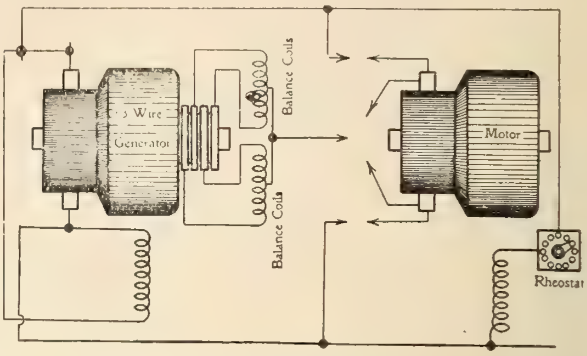

Fig. 3.—Three-Wire or Double-Current Generator and Circuits Therefrom.

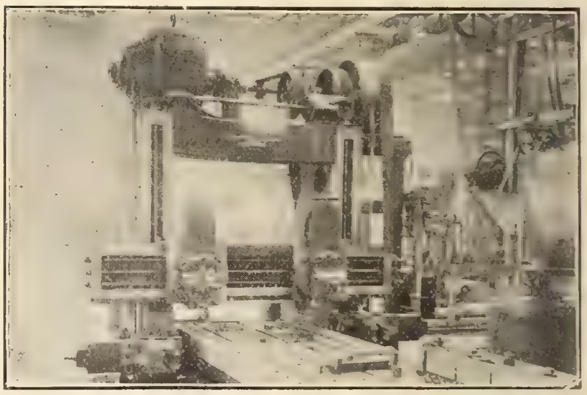

Fig. 4.—High-Speed Planer; Constant Speed Motor Connected by Gears to Countershaft.

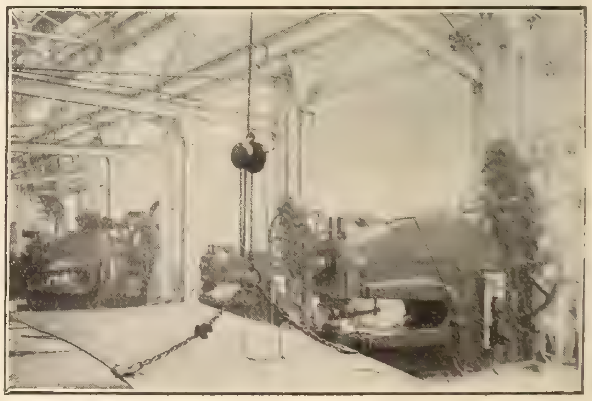

Fig. 5.—Direct-Connected Motor-Driven Punches and Shears in Boiler Shop.

This system of varying the speed of motors has been

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developed under the supervision of Mr. N.W. Storer, of the Westinghouse Company at Pittsburg, and it is called the Storer system.

For a number of years two generators in series, as well as rotary converters, have supplied energy to Edison three-wire circuits, but the use of a single generator such as that above described for this purpose is a more novel arrangement, and its simplicity and smoothness of operation commends it in an especial manner whenever two voltages are required for any purpose. When it is desired to obtain alternating current from a three-wire generator, the "balance coils" are generally replaced by transformers the secondary coils of which may be for any designed voltage required.

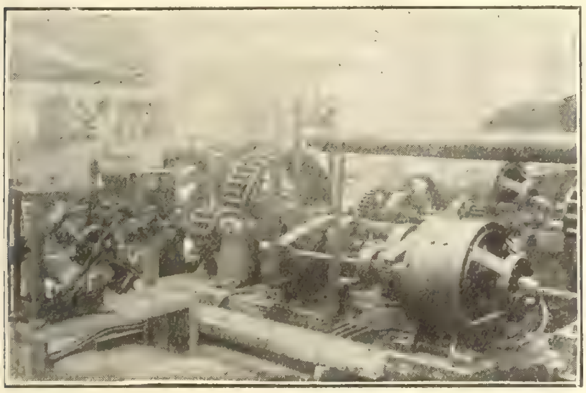


Fig. 6—Bending and Straightening Rolls in Boiler Shop, Driven by Variable Speed Motors. Commutator Type Reversible Controller Shown at left of Picture.

Simple three-wire circuits are run throughout all the shops of the Locomotive and Machine Company. The lighting, both arc and incandescent, is done at 115 volts; the constant speed motors are operated at 230 volts, and the variable-speed motors are connected by means of their controllers to the 115 or the 230 volt circuits as required.

When a change of tool-speed is desired, there is no changing of gears or shifting of belts—a simple movement of the controller handle is all that in necessary, and the result is such a saving of time and energy on the part of the tool operator that the shop's output is limited only by the capacity of the tools. The shops of the Locomotive and Machine Company continuously afford practical proof of this statement.

Fig. 7—Variable Speed Motors Geared to Tools Machine Shop.

With the exception of the crane motors, which were supplied by the Canadian General Electric Company, all the motors in these shops, together with their switches, starting rheostats, controllers, etc., were supplied by the Westinghouse Electric and Manufacturing Company. The controllers in use on the variable-speed motors enable the tool operators to obtain a speed range of 4 to 1. There are fifteen steps or notches on the controllers for different speeds in one direction and six notches in the reverse direction. The speed changes are made in nearly equal increments throughout the whole range; tools that may require a greater speed range than 4 to 1 are equipped with gears or cone pulleys.

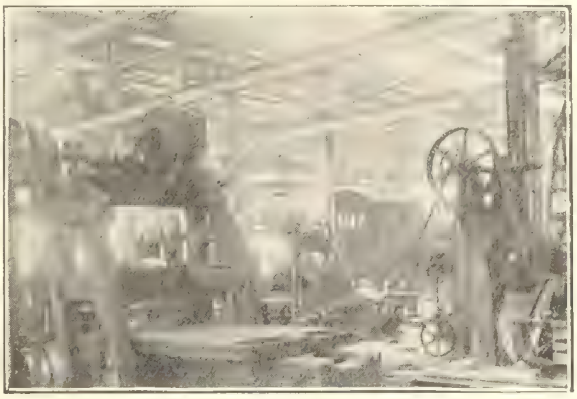


Fig. 8.—Constant Speed Motors Driving Tools: (a) by Renold Silent Chain; (b) by Belts.

The chief feature in a motor-driven shop is that the tools may be constantly worked to their utmost capacity, and the productiveness of such a plant is in many instances a revelation to those accustomed to old style equipments.

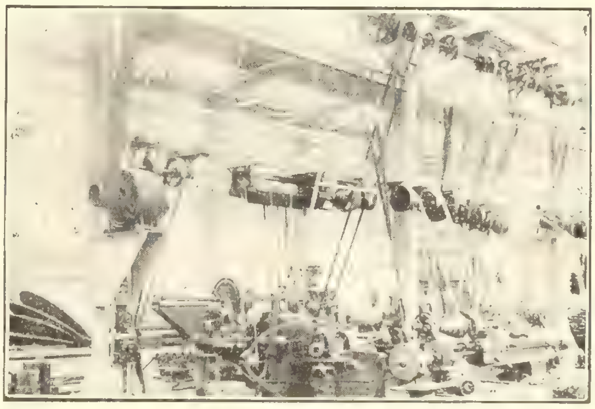


Fig. 9.—A Group of Small Tools Driven by a Countershaft.

Another important feature is the power saved by the elimination of shafting. Then there is the addition to the clear-head room space and the greatly improved lighting. The latter results are well exemplified by the accompanying illustration.

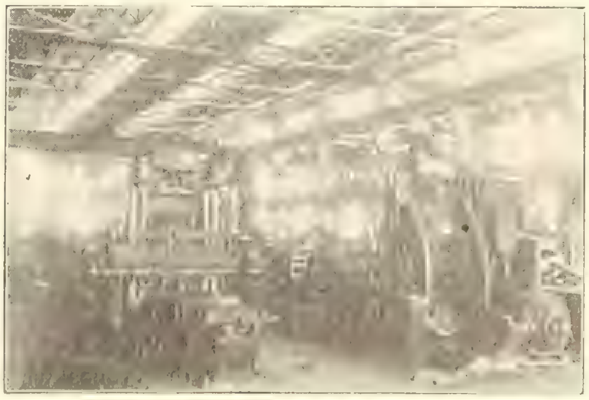


Fig. 10—Motors Direct Connected to Tools—Showing Neatness of Equipment and Accessibility of Controller Handle for Speed Varying Purposes, Etc.

At the present time the Locomotive and Machine Company have in use motors to the number of 140 in sizes varying from the 3 h.p. machines on some small shapers to the 60-h.p. motor driving the blower in the foundry. There are shunt, series and compound-wound motors in this equipment. Groups of small tools are driven by shunt motors as are also constant speed tools ; tools that may be started with a load on them are driven by compound-wound motors. The cranes are supplied with railway type series motors. The plate bending and straightening rolls are driven by compound-wound machines, the series coils of which have been made unusually strong in order to enable the motors to perform the work which is required of them. Series motors have been usually placed to drive rolls, but this practice necessitates constant attention on the part of an attendant, in order to prevent accidents from occurring immediately after the plates go through the rolls. On the other hand, the shunt winding on the compound motor prevents overspeeding and does away with the special attendant.

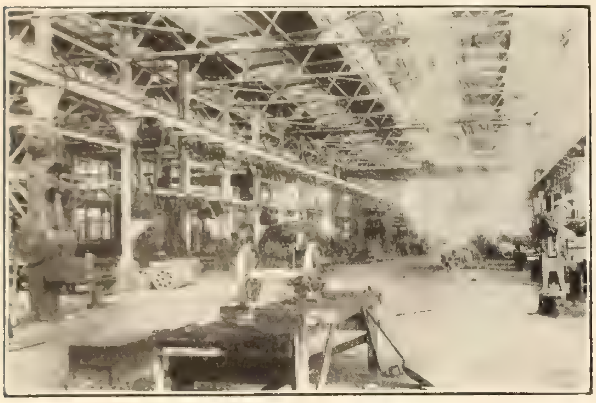


FIG. II.—VIEW IN ONE OF THE MAIN AISLES OF MACHINE SHOP. CLEAR HEAD ROOM AND GOOD LIGHTING SECURED BY ABSENCE OF BELTS AND SHAFTING, PULLEYS, ETC.

All the shunt-wound motors in these shops have been designed to operate satisfactorily when their speed is increased 40 per cent. by field weakening, and they are provided with rheostats for this purpose. In the event of further developments in the production of high-speed tool-steel, the advantage of being able to speed up the constant speed motors without having to resort to a change of pulleys is one of their most valuable features.

The Locomotive and Machine Company's shops are driven by electricity, and they were built by electricity. A temporary shop was erected near the site of the present shops and in it were set up punches, shears, air-compressors, cold saws, rotary planer, rivet and bolt makers, pneumatic reamers, and riveters ; in fact, a large part of the structural steel plant which has since been permanently installed in the structural steel shop —and in this modest structure the entire frame work of all the shops was fabricated. Induction motors supplied with current from Shawinigan Falls were the source of energy for all these tools. A double-commutator Western Electric, 115-230 volt generator was also set up in the temporary shop; it supplied current for lighting the grounds and for the cranes which were set upon their tracks before the buildings were roofed. The cranes were thus enabled to materially assist in the work of unloading cars and setting up tools, etc., long before the power house was ready for operation. This generator coupled to an induction motor now forms part of the power house equipment.

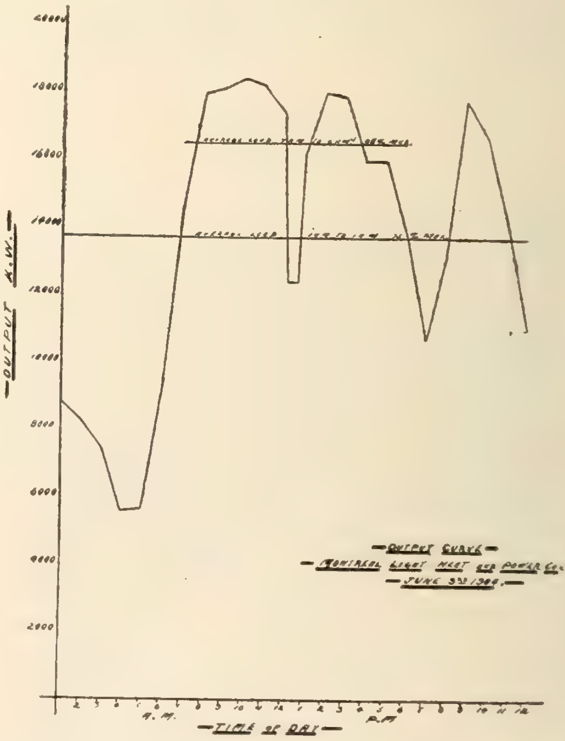
Any person interested in the construction of locomotives, the fabrication of structural steel, or in electrically-driven machine tools, will be well repaid by a visit to the works of the Locomotive and Machine Company, whose officers and management are at all times most courteous in affording opportunities to inspect their shops.

HIGH LOAD FACTORS.

Pehaps the most notable feature in the operation of the system of the Montreal Light, Heat & Power Company is the high load factors obtained. According to Mr. R. M. Wilson, B. Sc., who contributes an article to the Montreal Electrical Hand-Book, the minimum load factor over 24 hours per day during the summer manths is 74 per cent. and during the winter months 76 per cent. to 77 per cent., giving an average of about 75 per cent. tor the whole year (see output curve). The total output for the year 1903 is in the neighborhood of 85,000,000 k. w. hours.

These exceptionally good results have been attained through the policy adopted by the company. During the winter months the maximum lighting and power load is not coincident. This is brought about by the company making a very attractive rate for power which in not used between the hours of 4 p.m. and 7 p.m. of each day during the above months.

Electric light and power is distributed by the Montreal Light, Heat & Power Company in the City and Island of Montreal for a distance of about 16 miles along the river front, and to an average width of four miles back from its bank, and included in the service area is a strip of territory about one mile wide and four miles long on the main land opposite the city. Within the service are there area at the present time 10,600 customers using commercial arc and incandescent lamps, and 880 customers using motors, besides the towns in the suburbs supplied with street lamps.



The Carleton Place Electric Light Company have entered into a new agreement with the Town Council for lighting, under which the town will pay $7 per year for 32 c.p. lamps, to be in operation every night in the year from dusk to daylight. The contract is for ten years and calls for not less than 150 lamps.

CANADIAN ELECTRICAL NEWS TECHNICAL SCHOOL

The member of our staff who has charge of this department has been unavoidably absent from the city for several weeks and his treatment of the questions has not reached us up to the time of going to press. We shall therefore repeat the questions of last month and hope that this will give an opportunity for a good many more answers to be sent in.

7. What are the usual forms in which we have to deal with or measure energy?

8. What are the functions of a volt meter, ammeter, wattmeter, ampere-hour meter, integrating wattmeter?

9. What does the steam engine indicator give you and how do you make use of this?

10. A small lake discharges through a waterfall. What power can be obtained from it?

We also give the following three questions asked by a correspondent:

1. What changes are necessary to reverse a two-phase induction motor?

2. What are the usual sizes of German silver wire used for making electric heaters taking 4 amps., 6 amps., 7½ amps. and 10 amps. respectively?

3. What composition is used for embedding wires of small electric heaters used for cooking purposes?

ELECTRIC MINING EQUIPMENT.

The British Columbia Copper Company's smelting works at Greenwood, B.C., were designed with a view of eventual enlargement to a maximum treatment capacity of about 1,800 tons per diem, but their present capacity, with two furnaces running, is between 700 and 800 tons of ore per day. The first furnace was blown in on February 17, 1901, the second about a year later, and recently a Bessemerizing plant was added. The following particulars of the engine and motor equipment are found in the British Columbia Mining Record:

The engine and blower house, 60 × 45 feet, contains two No. 7½ Connersville blowers, the high-pressure cylinder of a compound condensing Reynolds-Corliss engine 16 × 35 in. rated at 150-h.p. with 100 lbs. steam pressure, and an electric light dynamo with direct-connected engine. In the adjoining 45 ft. × 40 ft. boiler room there are three horizontal return tubular boilers 66 inches × 16 feet, each of 100-h.p. and equal to a steam pressure of 130 lbs. Space was left for housing more boilers, but as electric power has been substituted for steam power throughout the works the earlier intention to double the steam power will not now be carried out.

The blast for the converters is furnished by a Nordberg blowing engine with cylinder 40 in. diameter and 42 in. stroke, having a capacity of 5,000 cubic feet of air per minute, at 12 lbs. pressure. This compressor is operated by a rope drive, the fly-wheel being 18 ft. in diameter and power furnished by a 300-h.p. variable speed motor operating at 2,000 volts.

For the transmission of electricity the B.C. Copper Company has built a pole line, with two independent three-phase circuits, to connect with the sub-station of the Cascade Water Power & Light Company at Phœnix, a distance of four and four-fifth miles. This line terminates in a brick sub-station containing step-down transformers from 20,000 to 2,000 volts of 1,000-h.p. capacity. From this sub-station the alternating current is transmitted at 2,000 volts to the power house in which are located transformers with a further step-down to 550 volts.

A 75-k.w. motor generator furnishes the direct current required for travelling crane and the necessary power for trolley locomotives to be used in the immediate future; a 300-h. p. motor previously referred to drives the Nordberg compressor; there are two 100-h.p. motors for the two blast furnace rotary blowers and one for the sample mill; a 40-h.p. motor drives the converter lining machinery; a 20-h.p. motor operates the hydraulic accumulator for tilting the converters; a 15-h.p. motor runs elevators connecting the blast furnace tapping and charging floors, and a 5-h.p. motor the sample grinding machinery. The lighting of the plant and premises is provided for by a series of transformers, each having a capacity of 150 lamps.

FATAL BOILER EXPLOSION.

A disastrous boiler explosion occurred at the rolling mills of the Toronto Bolt & Forging Company, at Sunnyside, near Toronto, on Wednesday, September 14. Six persons were injured, two of whom have since died. The accident occurred about 2 o'clock in the afternoon, when over seventy men were at work. The force of the explosion was terrific, but the boiler did not burst—it was simply thrown over on one side. The brick work was demolished and the iron smokestack fell, crashing through the corrugated iron roof of the building. Beyond the damage to the roof the building was not wrecked. The six men injured were standing near together to the west of the boiler and were hurled several feet.

The cause of the explosion is said to have been low water, as the jury at the inquest found that "John Dixon came to his death by the explosion of a steam boiler, caused by lowness of water, and also that the wooden plug used was not the proper thing for a water gauge."

Concerning the explosion the Canadian Casualty & Boiler Insurance Company, of Toronto, in a letter to their customers, say: "This boiler explosion is the third which has occurred during the last three months in the Province of Ontario, and in each case the cause has been traced to negligence, demonstrating that boilers do explode, consequently we now write requesting that you caution your engineer concerning the safety valves, glass water gauge, try cocks and blow-off pipes. These should always be kept in perfect working order—the first, that it may relieve the boiler of any undue increase of pressure; the second, that the exact height of water in the boiler may always be correctly known; and, the third, that they may not leak and cause a dangerous shortness of water."

FURTHER IMPROVEMENTS.

Since the Packard Electric Company, Limited, of St. Catharines, commenced business, the growth of the concern has been conspicuously noticeable because the increasing demand for its products has constantly forced increased facilities with which to keep apace with the demand for the company's goods. In the selling department it has been found necessary to establish branches in Winnipeg and Montreal, while the manufacturing plant has heretofore been overhauled and reinforced, and still the demand for Packard lamps, transformers and meters goes merrily on to such an extent that the present time finds the company engaged in elaborate extensions of its splended factory at St. Catharines by which its facilities will be still further increased.

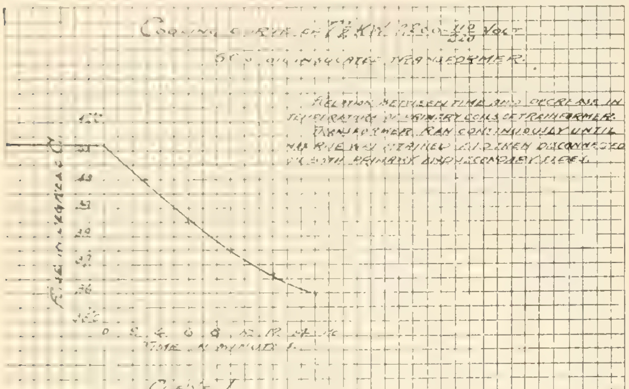
NOTES ON TESTING.

By M. A. Sammett,
Of the Montreal Light, Heat and Power Company.

Whether it be the manufacturing company verifying the results of their design or the operating concern making an acceptance tsst of the apparatus ordered, with the object of finding if the machine is within the guarantee limits of the manufacturer, precision in the work of testing such apparatus is of great importance.

Considering the fact that the designing engineers are apt to err on machines of special design and that in standard machines the design is based on a certain quality of material which is likely to vary, one would readily see why operating concerns are justified in going to the expense of fitting out a good testing department, in order to know thoroughly the performance of the machines they are purchasing.

In the present instance the writer intends to call attention to the importance of temperature rise of apparatus under load. Allowing that the performance of the machine in every respect meets the specifications of the designer, and that the apparatus would be acceptable to the purchaser, having met the guarantee, show many operating concerns do go to the trouble of finding this very vital point of the apparatus. The actual temperature of the machine under operating conditions is the criterion of its longevity and it is just as important a point for an operating concern, if not more so, than the efficiency of the machine.



While it is desirable to have the efficiency as high as best practice can secure, the question of actual temperature is a question of life of the machine, as excessive heat is not conducive to permanency of insulating material. Excessive heat charring and disintegrating the insulating material causes eventually the "break down" and it is this maximum temperature which should command our attention.

In all modern well designed machines, the importance of ample radiation is given proper attention, by making the winding well distributed, and as the determination of maximum temperatures is possible only for the manufacturer, who, while experimenting on new types of machines, inserts, in places of maximum temperature, exploring coils, and so derives his data, this method of determining the temperature of apparatus is out of reach of the purchaser.

The method often employed in a testing room of an operating concern is the determination of temperatures by thermometer. It is needless to say that the latter is as much of a crude and primitive method in determining temperatures of the conductors of the apparatus as the first method, where exploring coils are used, is accurate and valuable.

As a golden mean between the two, the method of determining the temperature by increase of resistance is sufficiently accurate, giving the average temperature rise of the entire coil above the temperature of the surrounding air.

Determining the resistance, it is desirable to use a method which renders the measurements to be taken both quickly and accurately. The galvanometer method, while offering a considerable degree of precision, is rather a slow method, and unless the resistances are taken immediately after the apparatus is disconnected from the circuit, as is the case in transformers, we do not get the actual temperatures, on account of the rapid cooling of the machine as indicated by curve of Fig. 1.

In motors and generators, some time is bound to be lost, depending on the relation of the inertia of the revolving element and the friction and windage of the machine. Hence, hourly readings are hardly attainable, except in stationary or non-revolving apparatus.

The drop of potential method would naturally appear to be the quickest one, when properly used. Ordinarily, the determination by drop of potential is done by using two separate meters, an ampere and a volt meter. By using two meters two men, as a rule, are necessary in taking readings, and what is more important, there are two meters to get out of order.

As it is of utmost importance to have the meters either exact or carefully calibrated, to secure reliable results, a modification of this two meter method, where only one meter is used, and where the calibration of the meter is of no importance, the results depending entirely on known resistances, is to be described in this article. The method was used by the writer for some time and found absolutely reliable and, though looked upon with some suspicion by representatives of manufacturing companies, in acceptance tests, it gave results very close to those found by the two meter method with standard instruments. The transformer temperature rise curves gave a smooth curve, taking in all points obtained by this method, thus showing the latter method to be very accurate. (Fig. 2.)

Besides having to use two separate D. C. instruments for the drop of potential method of measuring resistances when apparatus of widely different resistances is to be tested, a set of two instruments would not answer the purpose satisfactorily, and it would be necessary to either have a low reading voltmeter with two or more scales or an ammeter with several shunts.

In the testing department of the General Electric Company, at Schenectady, N. Y., the multiplicity of voltmeters is done away with by the use of a milivoltmeter and a Wheatstone bridge. The known resistances of the bridge are inserted in series with the milivoltmeter and knowing the meter resistance and resistance of leads, which are constant values, and the variable resistance in series that of the bridge, the voltage for any deflection can be calculated. This enables one to make use of the milivoltmeter for a wide range of voltages.

Not adding any resistance in series, the meter is used as an ordinary milivoltmeter, giving as its maximum value 100 millivolts, or 0.1 volt. Introducing resistances in series, the highest voltage that the meter would read will depend on the resistance available in the bridge. With say 11,000 ohms resistance, the maximum voltage that can be read on the same milivoltmeter will be equal to $\frac{.100\text{x}(3.512+0.106+11,000)}{3.512}=313.3$ volts.

Where 3.512 is the meter resistance in ohms ; 0.106 resistance of leads in ohms ; 11,000 ohms bridge resistance in series with meter and 0.100 full scale indication of the meter. Though by this means a variable voltage range is secured, the method cannot be favorably compared with the one where only one milivolt meter is used for both current and voltage indications, and the accuracy of the meter done away with.

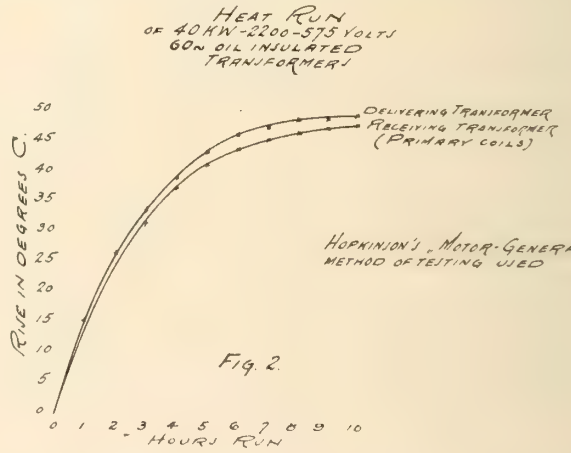


Fig. 2

Suppose we make several shunts so adjusted with the milivoltmeter resistance as to get certain multiples of meter indications expressed in amperes. In that case, amperes are equal to meter indications times shunt constant and with a constant e. m. f. supply, as that from storage batteries (see diagram Fig. 3), and with a double set of switches, the meter can be used as an ammeter when switch III is closed, and as a voltmeter when switch IV is closed. During resistance measurements, switches I and II are closed all the time, while III and IV are closed alternately. Rheostats for either series or multiple connections in series with main circuit are used.

Taking measurements, the current is adjusted for any deflection that may be desired, by the use of rheostats in series with the main circuit, and taking the voltage drop the adjustment for the deflection can be made at will by the introduction of resistances in series with the meter. Let us take, for example, the following figures :—

Shunt constant for ampere reading, 20.0; deflection for ampere reading, .070 ; deflection for volt reading, .065 ; resistance in series with milivoltmeter while measuring volts drop, 78 ohms.

Temperature of coils measured (same as room) 23°C.

The resistance of coils from the above data is found by dividing E by C, where

$$E = 0.065 \text{x} \frac{(78.0 + 3.512 + 0.106)}{3.512} = 1.515 \text{ volts}$$

and $C = 0.070 \text{x} 20 = 1.4$ amps.

$$\text{Then resistance} = \frac{1.515}{1.4} = 1.082 \text{ ohms at } 23^\circ\text{C.}$$

and at 25° C resistance = 1.09 ohms.

Since we can adjust the deflection of the voltmeter indication at will, we can make it equal to that of the indication of the current and so, equalizing the meter readings, we make the resistance we are measuring to be dependent solely on the bridge resistances, which are known in every case, and the meter and lead resistances, which are constant and a shunt constant.

Having equalized the meter deflections in the formula for the resistance, the values representing volt and ampere deflections cancel out, and the formula reduces to

$$R = \frac{\text{Resistance of bridge} + \text{Meter resistance} + \text{leads resistance}}{\text{Meter resistance}}$$

This independence of resistance measurements of meter indications is one of the best features of the method. No matter how irregular the meter calibration may be, once equal deflections by proper adjustment of bridge resistances are obtained, the results are bound to be accurate and no calibration of meter is necessary.

Making a careful check of the milivoltmeter, both as a volt and ampere meter, with standard instruments, the curves were found to be exactly coincident, showing that whatever correction there is to be applied to a certain reading of the meter used as a voltmeter, the same correction will have to be applied to that reading when used as an ammeter, the meter in both cases having a constant of 1.02 (see curve 2.)

With the advantages of reduction of number of meters to only one, requiring one man for taking measurements, and with a disregard for meter calibration, the method is one which should prove very useful in every testing room.

Let us now take an example, and see how a slight change in one of the measuring meters, using the two meter method for drop of potential, will effect the result.

Supposing the voltmeter was permanently effected by a stray field, making the voltmeter readings 3 per cent. high. Then measuring the resistance of the primary coils, we will get, wit the above assumption, a drop of 7.94 volts, with 6 amperes through the coils, or the resistance will be equal to 1.320 ohms, the room temperature being 21°C.

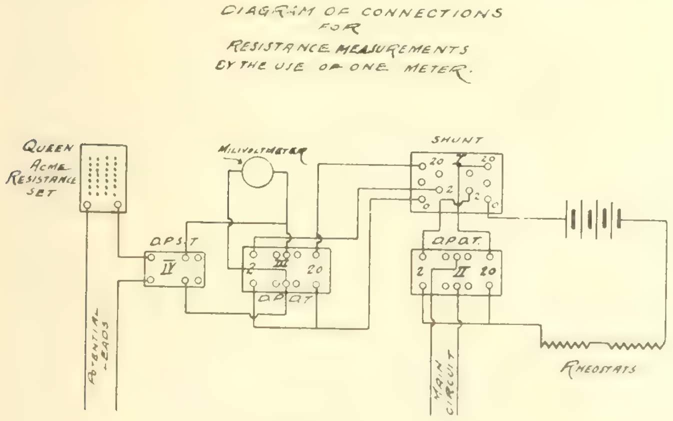


DIAGRAM OF CONNECTIONS FOR RESISTANCE MEASUREMENTS BY THE USE OF ONE METER.

FIG. 3.

The cold resistance as taken prior to heat run, reduced to 21°C, is 1.093. According to the rules of the Standardization Committee of the American Institute of Electrical Engineers, the formula to be used for determination of rise in temperature is as follows :

$$R_t = R_o (1 + .0042 t)$$

$$\text{and } R = R_o (1 + .0042 (t + o)$$

$$(t + o)$$

Where R_t = Initial resistance at room temperature.
$R_t + o$ = Resistance at temperature elevation o.
R_o = Inferred resistance at o C.

Temperature rise from the above formula is equal to

$$o = (238.1 + t) \frac{(R_t + o - R_t)}{R_t}$$

Substituting actual values, we get

$$o = (238.1 + 21) \frac{(1.320 - 1.093)}{1.093} = 53.8^\circ\text{C.}$$

And rise above room on basis of 25°C will be 54.8°C.

While using the method described in this paper, no matter how large the per cent. error of the meter, we get correct results. In this instance, whatever the meter calibration, we will get same results as given in table below.

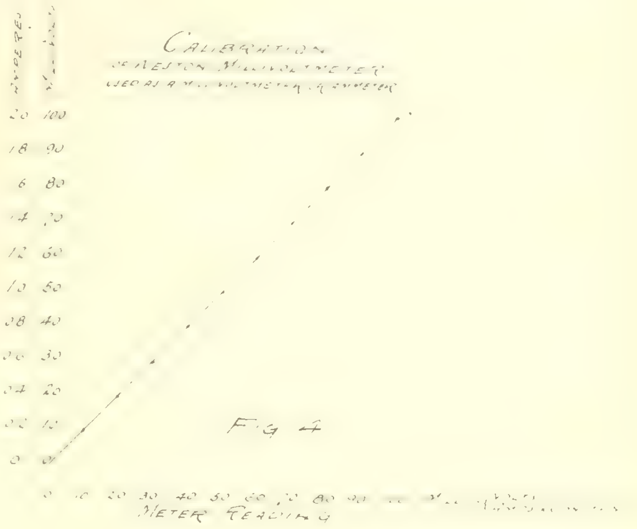


FIG 4

For the 2.30 p.m. reading we get a resistance of 1.28 ohms on the receiving transformer or a temperature rise of only 45.3°C, as against 54.8°C, derived in the above example.

This descrepancy is quite considerable, and in order to avoid unreliable results, a method, where the most likely error, that is the meter accuracy, is eliminated, cannot be to strongly recommended.

DELIVERING TRANSFORMER.

Time.	Volts.	Amps.	Room C.	Primary Res. in Ohms	Primary Rise above Room.	Rise above Room on Basis of 25° C.
8.30 a. m.	710	18.6	20.5	1.139	15.1	15.4
9.30 "	710	18.6	22.0	1.191	26.2	26.6
10.30 "	710	18.6	22.0	1.22	33.2	33.8
11.30 "	710	18.6	22.0	1.241	38.2	39.0
12.30 p. m.	710	18.6	22.0	1.259	42.6	43.5
1.30 "	575	18.19	21.5	1.27	45.6	46.4
2.30 "	575	18.19	21.0	1.271	46.5	47.4
3.30 "	575	18.19	21.0	1.278	48.0	49.0
4.30 "	575	18.19	21.0	1.278	48.0	49.0
5.30 "	575	18.19	21.0	1.280	48.7	49.6

RECEIVING TRANSFORMER.

Time.	Volts.	Amps.	Room C.	Primary Res. in Ohms.	Primary Rise above Room	Rise above Room on Basis of 25° C.
8.30 a. m.	710	18.6	20.5	1.15	13.8	14.1
9.30 "	710	18.6	22.0	1.208	26.	26.4
10.30 "	710	18.6	22.0	1.228	30.8	31.3
11.30 "	710	18.6	22.0	1.255	37.1	37.7
12.30 p. m.	710	18.6	22.0	1.27	40.7	41.3
1.30 "	575	18.19	21.5	1.279	43.3	44.
2.30 "	575	18.19	21.0	1.28	44.5	45.3
3.40 "	575	18.19	21.0	1.285	45.5	46.4
4.30 "	575	18.19	21.0	1.290	46.7	[illegible]
5.30 "	575	18.19	21.0	1.291	47.	48.0

The Brantford Electric & Operating Company, of Brantford, Ont., are now quoting the following prices for electric lighting : Commercial lighting, 10 cents per 1,000 watts, with 10 per cent. discount for prompt payment; private dwellings and churches, 9 cents per 1,000 watts, with 10 per cent off. Special discounts for large monthly bills as follows : $10 or over, 15 per cent. discount; $20 or over, 20 per cent.; $30, 25 per cent.; $50, 30 per cent. Lamp renewals are free, and meter rents as follows : 15 light meters, 10 cents a month; 30 light meters, 20 cents; 50 light meters, 30 cents.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

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The International Electrical Congress. In last issue we referred to the then approaching International Electrical Congress at St. Louis as likely to be a most important event in the history of electrical science. The Congress proved to be all that was expected of it, and has been pronounced by all participants a distinct success. The total attendance was about 700—probably equal to the International Electrical Congress at Chicago in 1893. The St. Louis Congress, however, excelled chiefly in one point, namely, the volume and quality of literature pertaining to electricity presented to the delegates. Some 160 papers were read before the eight sections, and on many of them there were very interesting discussions. It is the intention to distribute the printed transactions before the close of the year, each delegate to receive a copy, which, we feel sure, will be greatly prized. The work of the Chamber of Delegates was an important feature of the Congress. The Chamber is composed of the official representatives of the different Governments—France, Germany, Great Britain, Argentine Republic, Australian Colonies, Denmark and Sweden, Italy, Hungary, India, Mexico, Spain, United States and Canada being represented. Mr. O. Higman, of Ottawa, was the representative of the Dominion Government. The province of the Chamber of Delegates is to consider and fix international units and standards for electrical apparatus. Three previous conventions for a similar purpose have been held, in Paris in 1881, Chicago in 1893, and again in Paris in 1900, from all of which good results were obtained. The Chamber of Delegates at St. Louis recommended a more exact, scientific and authoritative method of fixing electrical standards, and the appointment of a permanent international commission, with two delegates from each country interested in electrical standard-unit legislation, for that purpose.

The many excellent papers presented at the Congress can only here be briefly referred to. The one by Dr. Kennelly and Mr. Whiting on "The Present Status of the Edison Storage Battery" was very acceptable, for there has been a desire on the part of electricians to know more of this invention. The authors give a thorough description of the cell, which has steel grids, with oxide of nickel as the active material of the positive plate, and iron as the active material of the negative plate. The mean electromotive force of discharge is 1.3 volts. With 100 per cent. ampere-hour efficiency, the watt-hour efficiency is 65 per cent. Successive improvements in the battery have been made, based on defects discovered in actual vehicle practice, for which the battery is specially adapted. Experience has proven the Edison cell to be very durable, no electrical depreciation being discernible in three years' work. According to observations, the cells lose 15 per cent. of the ampere-hour charge in eight weeks of idleness, which is a much better showing than has been made by other cells. Tests showed the cells to be remarkably immune from deleterious effects due to careless treatment, those which had been allowed to dry out, had been permanently short-circuited, or even charged in the wrong direction, having shown a full restoration of their capacity after a prolonged restoring normal charge. According to the authors, who are considered impartial, the Edison cell, in its large output at heavy discharge rates, its low depreciation in capacity and its durability under severe and adverse treatment, approaches the capabilities of a piece of mechanical apparatus more nearly than is ordinarily credited to electrolytic structures.

Among the papers which principally interest central station managers was one by Mr. Etienne de Fodor entitled "Rates for Electricity Supply". The author pointed out that competition with gas had been the controlling factor in fixing the prices for electric current used for lighting and power. The gas motor had not made much progress, however, owing to the fact that the electric motor possessed many specific advantages, such as simplicity of service, noiselessness, cleanliness, small space required, etc. Power users were now demanding the same rates for light as for power, the precedent for such demand having been established by the gas companies, who permit customers consuming "industrial" gas to use a certain limited number of lights taken from the same meter which supplies the gas for industrial purposes. Electrical central stations must therefore accommodate themselves to this custom in order to effectually compete with gas. A table given of the prices charged for electrical energy in fifty cities showed that the normal unit price for power current is about one-third that charged for light. The author advocated the establishment of a unit rate for light and power, such rate to be divided into two classes or steps, according to the time at which the energy is consumed. Unfavorable peak loads due to the simultaneous operation of motors and lamps in the evening could be obviated by such a double-tarriff system when there is a great difference between the maximum and the cheaper rate. The consequence of such a tariff system would naturally be to raise the original low price for power current. Such increases in motor current rates had already been introduced in a limited manner in some of the latest current tariffs. The author did not fear that the electric motor would be dispensed with even if the cost of the service should be increased. One of the most formidable competitors, the generator-gas motor with its cheap service, had not only made no advance against the electric motor, but had shown that it is not even a competitor of the ordinary gas motor. Another timely paper read before Section E was by Mr. W. C. L. Eglin on "Rotary Converters and Motor-Generator Sets". Mr. Eglin states that the percentage of the total load of electrical supply companies converted for direct current varies widely in the different localities, the difference being as much at 30 to 100 per cent. Three methods are available—rotary converters, motor-generator sets and rectifiers. Speaking of the first method, he said that rotaries might be started from either side, but preferably from the direct-current side; when starting with alternating current, from 50 to 100 per cent. more than full-load current is usually required, for the regulation of which some means of control must be provided. The field must also be cut out until synchronizing speed is reached. A good form of electrical speed limiting device consisted of a differential relay, one set of coils connecting to the alternating-current bus, the other set to the collector rings. Should the rotary exceed its normal speed, the frequency at the collector rings will increase, causing an unbalance at the relay, tripping the circuit breakers.

The papers presented before the Electric Power Distribution Section brought out much information regarding high voltages. In Prof. Baum's paper on "High Potential Long-Distance Transmission and Control" mention was made of some practices which are not in general use, his remarks being based on experience with the operation of the California Gas & Electric Company's system, which embodies over seven hundred miles of line and potentials approaching 60,000 volts. He gives it as his opinion that very high voltages are best for lines over fifty miles in length and are to be chosen in preference to low voltages because experience had shown them to be more free from trouble. On the question of surging, he concludes that for equal energy, the higher the voltage the less danger from surging. He mentions that at one period the Bay Counties' plant for several weeks supplied customers for over 350 miles of circuit with entire success. The announcement that he had practically abandoned lightning arresters, using only the horn type with wide gaps, and that he considered even these rather needless when using 60,000 volts, created a lively discussion, many engineers taking issue with him on that subject. He claimed that with the required insulation for 60,000 volts with a proper factor of safety, there is little danger of minor lightning discharges such as work havoc on a low tension line, and it was sometimes better to take trivial chances of a short-circuit from a first-class thunderbolt than to be in constant trouble from delicately set arresters that work too often. The discussion emphasized the fact that what is needed in insulators is more careful design to make the best use of the material without increase in size. It is at present possible to procure insulators that will stand a voltage of 50,000 to 60,000 with a factor of safety of somewhat less than two, although no plant is yet operated commercially at full 60,000 volts. On the question of iron versus wooden pins for transmission purposes, opinion was greatly divided, but the former probably received the better of the argument.

The Electric Communication Section also had its quota of valuable papers, most of which we must pass over for the present. The paper by Herr Hollos, of Hungary, on "Simultaneous Telephony and Telegraphy," brought out the point that either one service must of necessity be superior to the other unless the Government, for instance, operates both services to their best efficiency. One of the greatest difficulties attendant on simultaneous practice was connecting two distinct circuits. He advised the use of a repeating coil, which, however, cuts down the telephone efficiency. A paper on "The Telephone Problem in Large Cities" brought up the merits of manual and automatic exchanges, both systems finding a number of advocates.

The Delano Osborn Engineering Company, consulting engineers, Montreal and Toronto, have been retained by the city of Charlottetown, P E.I., to prepare plans and estimates for a municipal electric lighting plant. Contracts with the existing local company for town lighting will soon expire, and the council have decided to fully investigate the question of municipal ownership before renewing the contracts at the prices asked.

INVENTION and DEVELOPMENT

IN THE ELECTRICAL FIELD

New Continuous-Current Dynamo.—Hon. Charles A. Parsons and G. G. Stoney, of Heaton Works, Newcastle-on-Tyne, have jointly invented a continuous current dynamo which possesses several novel features, the chief of which are (1) a practically fixed line of commutation at all loads without sparking ; and (2) an increase in the allowable ampere-turns per inch diameter of the armature, so that an increase of output of at least two or three times may be obtained from a machine of given size. Further, provision is made for the ready removal of the armature when required.

The Auto-Telegraph Car.—What is regarded as a distinct advance in the field of electrical communication is the auto-telegraph car, a motor vehicle of unique design which has just been completed to the order of the United States War Department. At the sides of the car are racks on which are carried lances and light poles for use in erecting temporary or overhead telephone or telegraph lines when other supports are not available. There is ample storage space for instruments and other equipment, which are selected with a view to their mobility. For instance, the Signal Corps is now making use for field lines of a wire so light that a reel of it may be carried in a man's pocket. This "flying" telegraph office" is equipped with all the latest improvements, including "sounders" especially adapted to the receipt and transmission of messages amid the clash of arms or other excessive noise.

Single-Phase Railway Motor.—The London Electrician gives a description of a single-phase commutator motor invented by Dr. Behn-Eschenburg, of the Oerlikon Company. It is a 35-h.p. motor which runs normally at about 1,000 r.p.m. and is designed so that it may be run : (1) as an ordinary continuous-current series motor from a 200-volt supply ; (2) as a series motor for single-phase currents at 200 volts and frequencies from 0 to 25 ; (3) as a repulsion motor, when fed with single-phase currents of from 40 to 50 periods per second and at a pressure of 250 volts, or (4) as a compensated series motor of the Latour type, being fed in this case with single-phase current at 250 volts. The rotor and stator are each equipped with a six-polar, distributed winding, embedded in slots and in appearance resembling very much the ordinary winding of a continuous-current armature. No resistance is inserted between the armature coils and the respective commutator segments. In the first three cases, six brush spindles are required, but in the fourth case 12 brush spindles are necessary. The carbon brushes are 8 mm. wide in all cases. When the motor is used for the purposes (1) and (2), the brushes are fixed at the neutral points and the stator winding is split up into two identical parts, the magnetic axes of which are shifted relatively to each other by one-half of the pole pitch. One part serves for producing the field and corresponds, therefore, to the field winding of the ordinary continuous-current series motor, while the other part—the compensating winding—nullifies the detrimental effect of the field emanating from the loaded armature. For employment as a repulsion motor or as a motor compensated on the Latour system, the two parts of the stator winding are connected together, so as to form one evenly distributed winding only. The air gap is 1 mm. wide. Eight diagrams are given, showing the behaviour of the motor under various conditions. The efficiency of the motor when running with continuous current is about 3 per cent. higher than with alternating current. The power factor of the ordinary single-phase series motor is better by about 3 per cent. than that of the repulsion motor. For speeds from 800 to 1,000 r.p.m. the commutation is said to be excellent for all four ways of working, but for speeds below 500 r.p.m. and above 1,000 r.p.m. the commutation is satisfactory only when the motor is run as a continuous-current or alternating-current series motor. In the other two cases special arrangements have to be provided to reduce sparking when the above limits of speed are not observed.

70,000-Volt Direct-Current Tests. — Experiments with high voltage distribution on the direct-current system have been carried out at Geneva, Switzerland, under the direction of M. Rene Thury, who is the champion of the high voltage dirrect-current system. M. Thury seems to have proved that his ideas are correct by the successful operation of the St. Maurice Lausanne high tension line. From an article in the Electrical Review by B. F. Hirshauer, it is learned that the line uses no less than 23,000 volts direct-current, with a constant current of 150 amperes. This high voltage is obtained by coupling several direct-current dynamos in series. In order to test the high tension lines it was decided to build a machine which should produce 23,000 volts directly. As this proved a success M. Thury proceeded to construct two others of somewhat higher voltage. Then, by connecting these three machines in series, he was able to reach the remarkably high tension of 70,000 volts direct-current. Interesting tests were made to find what would be the limiting voltage which could be used on a high tension line in practical work. The object of the first series of tests was to find out how the standard forms of line insulators would behave towards 70,000 volts direct-current, and especially to compare the latter with alternating current of high voltage. The results showed the direct-current to be much superior to the alternating current in regard to porcelain insulators and in general to different kinds of insulating material. They also showed that the loss from insulation, even in time of fog, is practically zero at a voltage of 22,000, and it was to be foreseen that this voltage could be greatly increased before the losses by air and insulation would be appreciable. It seems certain at present that the limit voltage which we cannot exceed with the material we now pocess is much above 70,000 volts for direct-current, between the line and the ground. Thus the use of direct-current enables us to reach, industrially and very economically, distances which are more that double those which are attained with great difficulty by means of polyphase currents; that is to say, by the use of direct-current, we can now reach a distance of 200 miles with only ten per cent. loss and 65 pounds of copper per horse-power transmitted. As high as 600 miles is covered with the same weight of copper and somewhat less than thirty per cent. loss.

LONG SPANS FOR TRANSMISSION LINES.*

By F. O. Blackwell.

Many cities to-day are dependent for their lighting, transportation, water supply and the operation of their industries upon electric power transmitted over considerable distances.

Unfortunately, interruptions of the power service occur not infrequently, and when they do happen they so inconvenience the public as to be most conspicuous. The impression that long-distance power transmissions are unreliable has some basis of fact that seriously interferes with their development. Although absolutely continuous service may not be possible, many of the troubles now experienced can be either altogether eliminated or greatly reduced. Among the principal causes of interruption, so far as the line is concerned, may be mentioned :

Short-circuiting of lines by branches of trees, wires, or by large birds getting across them.

Burning of wooden pins, cross-arms and pole tops by leakage or electrostatic discharges from the conductors.

Burning of wooden poles at the ground from forest or prairie fires.

Failure of insulators from puncture by the current or their destruction by missiles discharged maliciously.

Lightning damaging the apparatus connected to the circuits and sometimes destroying poles.

Accidents due to heavy winds overturning the poles or to floods washing them out.

The deterioration of a line requires its replacement in from 5 to 20 years, depending on climatic conditions and the material which is used in its construction. This replacement of the poles with new ones can only be done by shutting off the current or at the risk of accidental interruptions.

Let us see what can be gained by substituting a steel-tower construction with long spans for a wooden-pole line. Short-circuits are by far the most common difficulty, the only remedy for which is to put the wires so far apart that they are unlikely to be bridged across. This can readily be done even with more than one circuit when a steel cross-arm is employed. Burning is of course entirely done away with where metal construction is used.

Failure of insulators from electrical causes can be obviated by getting larger and better insulators ; this is practicable where the spans are long and the number of insulators on high towers are much poorer targets than when they are near the ground and so are less liable to be broken.

Each metal tower is a lightning arrester, and as they are the highest points in the line they materially assist in its discharge ; and the tower itself, being a conductor, cannot be injured by lightning. Steel structures can be exactly figured to meet safely any strains that can come upon them and can generally be located only at safe places where there is no danger of washouts.

The deterioration of a properly constructed and well-galvanzied steel tower is very slight, as is proved by marine and windmill experience, and is practically negligible so far as the pins and cross-arms are concerned. Any part of a steel tower can be readily removed and replaced without interrupting the service.

By far the greatest gain obtained from long spans is in the reduction of the number of parts. If one insulating support takes the place of four or five, line troubles will be reduced nearly in direct proportion, the inspection and repair of the line will be much simplified and its cost of maintenance correspondingly diminished.

The cost of a tower construction as compared with wooden poles depends on the locality. Where the right kind of timber exists it is of course cheaper; but in tropical countries where wooden poles would have to be transported long distances the towers are much less expensive.

The first and most important consideration for long spans is the material of the conductor. Copper, aluminum and iron are available for this purpose. Various alloys of copper have great strength, but their conductivity is too low and their cost too high to compare favorably with the more common metals. Copper wire varies widely in its characteristics, depending on the methods used in its manufacture. The copper is received at the wire mill in the form of cast-wire bars, weighing 300 to 350 pounds. It is then rolled into rods and the rods are drawn into wire of the required size. The temperature at which the metal is rolled, the reduction of area both in rolling and drawing and the amount of annealing which the wire is given—all have an important bearing on its characteristics. As the size of the original wire bar is limited the smaller the wire the more it is worked and in general the better the result.

Each strand should be a continuous wire without joints. Joints in the cable should be as few as possible and made by means of sleeves, as brazing or soldering anneals the wire and much reduces its strength.

The advantage of aluminum is that it weighs less than copper for the same conductivity, but for long spans its lesser strength, greater diameter and higher coefficient of expansion are against it. Steel wire has about nine times and iron wire cable about six times the resistance of copper so that they are more expensive as a conductor than copper. In order to avoid oxidization it is necessary to galvanize iron or steel wire ; this partially anneals it and reduces its strength.

The strains upon the conductor are those due to its own weight and the wind acting upon its surface. In a cold climate in addition sleet may form upon the wire, increasing the weight and the surface exposed to the wind. On a line carrying any considerable amount of power it is improbable that sleet will ever form on account of the losses in the conductor slightly heating it. In order to be on the safe side, however, it is best to assume in the North a coating of ice one inch thick all around the conductor. The wind velocity could never exceed 100 miles an hour, which would give a pressure of 40 pounds per square foot on a flat surface or 20 pounds on a cylindrical surface such as that of a wire. The weight is of course a vertical stress and the wind a horizontal one at right angles to the wire. The greatest strain is caused by the resultant of these two. The worst conceivable condition is sleet on the wire, followed by extreme cold weather with high winds.

The maximum sag may be due to the conductor being loaded with sleet or to heating of the wire in a hot sun. The latter will generally be found to give the greater sag. Owing to the conductor being elastic, it is not necessary to consider the greatest deflection from a horizontal line between supports as the vertical sag of the wire. The wind pressure causes the wire to swing to one side, and it is elongated by the combined strain of wind and weight, but as soon as it is relieved of the wind pressure it swings back to a vertical position and contracts to the length required to carry its weight alone. The sag due to heating of the wire is also somewhat less than it otherwise would be, because when expanded the strain is less and the wire contracts.

The cross-arm is of course subjected as a beam to the weight and wind strains transferred to it from the cable, but in addition there is a torsional strain due to the breaking of a conductor that can best be borne by a pipe. The length of the cross-arm should be sufficient to space the wires well apart and prevent short-circuits either from objects thrown over the line or from the wires swinging together. The former is the more important, and if a safe distance apart, say six feet, is chosen it will be sufficient to guard against the latter, as on short spans with relatively less distance between wires they invariably swing together and never touch each other.

The most economical tower construction is one in which the spread of the legs at the ground is about one-quarter to one-third the height of the tower. If a less spread is used, the weight of the legs becomes excessive and with a greater spread the cross-bracing must be much increased in size. For a single circuit the common windmill tower construction in which the legs are locked together at the top has the advantage of reducing the strains to a simple compression of the legs on one side and tension on the other, the only function of the cross-bracing being to prevent the legs buckling when in compression.

Where there are two or more circuits the length of the cross-arm is so great as to require two points of support. The tower can then be made with a width at the top approximating that at the bottom and the cross-bracing has to bear its full share of the lateral strains. A truss construction with the fewest number of parts and opportunities for slack motion and racking of the tower is preferable.

ELECTRICAL MATTERS AT WINNIPEG.

All branches of the electrical trade in Winnipeg and throughout the west are very busy. The firms represented in this city state that their greatest difficulty is inability to fill orders quickly enough.

The Winnipeg Electric Street Railway Company are extending their lines in different directions. The connecting link between the city and St. Boniface over the Norwood bridge across the Red river was completed last week, and now the cars run over the bridge and around through St. Boniface without having to transfer passengers, which is a great saving of time. In a few weeks the subway at St. James, on the west side of the city, will also be completed and then there will be a straight run of about eight miles to St. Charles without a change of cars, and when the Main street subway is completed it will be possible to reach all the outside points of the city without having to change cars.

To meet this demand for power the Street Railway Company are building an addition to their power house, 110x55 feet, and are installing new engines, generators, boilers, etc. They are also building new shops in Fort Rouge and new car sheds in the north end of the city. The new shops are for construction work, the intention of the company being to build their own cars.

The Allis-Chalmers-Bullock Company have been very busy since opening their office in this city last July, all their western business being conducted from this office. They are installing an 800 k. w. alternating current machine in the Winnipeg Street Railway Company's new power house, also a plant at Moose Jaw which will be in operation early in November. The manager, Mr. L. J. Bellnap, is well satisfied with the outlook for business.

The electrical contractors in the city are very busy on account of the large amount of wiring and small installations to be attended to.

The Winnipeg General Power Company are progressing with their power development at Lac du Bonnet, Man., but it will be some time before their power will be coming into Winnipeg.

Winnipeg, Oct. 2, 1904.

THE ALLIS-CHALMERS-BULLOCK WORKS.

The new works of the Allis-Chalmers-Bullock, Limited, situated at Rockfield, Que., near Montreal, comprise five shops. All the buildings are of the most improved construction, and there is every facility for the handling of the work. The main machine shop is a building 400 feet long and 100 feet wide, divided into a centre and two aisles. In the centre are the heavy tools and heavy assembling department, while the smaller tools and detail departments are in the side aisles. The tool equipment is excellent and is to be further improved by the addition of many new tools especially adapted to the class of work to be carried on. It is intended to extend this shop and to erect beside it a twin shop, the two to open into a large assembly and store room, fully equipped with cross tracks and travelling cranes for the handling of all material. This, when completed, will make a machine shop 700 feet long and 200 feet wide.

Another building which is to be enlarged is the present power house. A large direct-current Bullock generator is to be installed to furnish power for the multiple voltage system of tool drive, developed by the Bullock Company, to be used throughout the shops. The power house is to be extended to a length of 300 feet and width of 60 feet, the greater part of it being used for the winding and assembling of the electrical apparatus. The foundry, a most important factor in a well ordered plant, is a building 200 feet long and 100 feet wide. The pig iron is unloaded directly from the railroad to the charging floor. A cupola of large capacity, a core oven, travelling crane, etc., make the equipmont complete. There is ample room for the extension of this building.

A blacksmith shop 100x80 feet, with modern forges and steam hammers, and a pattern shop 200x80 feet, complete the present plant ; but it is expected that additions other than named above will be made in the near future.

A new and well appointed office building is to be erected in the spring to accommodate the Montreal sales organization as well as the works staff.

The annual meeting of the Grand Valley Electric Railway Company was held in Brantford on September 14th. The reports submitted showed that the year had been satisfactory. The total receipts from the operation of the line between Brantford and Paris reached a substantial figure, and as a result the interest on the bonds was not only paid but a balance of $2,870 was shown.

VISIT OF ELECTRICAL ENGINEERS.

About three hundred of the delegates to the St. Louis International Electrical Congress visited Montreal on Wednesday and Thursday, September 7th and 8th, where they were entertained and afforded an opportunity of inspecting the electrical plants in and around that city. The Windsor Hotel was made their headquarters, and each delegate was given a badge which entitled him to the free use of the cars and telephones of Montreal during their visit. At 10 o'clock on Wednesday morning, by courtesy of the Grand Trunk Railway, a special train carried the party to Lachine, and after shooting the rapids an inspection was made of the main receiving sub-station of the Montreal Light, Heat & Power Company, where luncheon was served by the officers of the company. Mr. W. McLea Walbank, first vice-president and chief engineer of the company, presided. In proposing the toast to "Our Guests," Mr. Walbank said: "I am pleased to see the British, French, Italian and American electrical fraternity meeting in synchronism in our central station, and to tender you our high-tension greetings, our only regret being that your stay with us is to be so short and that you have come prepared with time-limit relay devices which even our high potential persuasions cannot break down." Mr. Walbank referred to the various stations in Montreal and vicinity. The Lachine Rapids plant, he said, was interesting because it is a hydro-electric plant being developed from a low head. The power from the wheels is transmitted by means of gearing to the generators, producing three-phase 60-cycle current direct from the machines at 5,000 volts. At Chambly, on the Richelieu river, about 80 miles from Montreal, there was to be found a hydro-electric plant with a head of about 30 feet and the generators directly connected to the water wheels and furnishing 60-cycle current at 2,200 volts, which is stepped up by transformers to 25,000 volts and thus transmitted to the city. At Shawinigan Falls there was an example of a hydro-electric plant of high head—some 150 feet—with pipe, flume, and direct connected wheels and generators, producing three-phase 30 cycle current at about 2,000 volts, which is also stepped up to 50,000 volts and transmitted to Montreal, where it is reduced to a voltage of 2,200 volts and a common frequency of 60 cycles, and, added Mr. Walbank, you see them in this station all working in parallel.

The toast was responded to by R. K. Gray, president of the Institution of Electrical Engineers of Great Britain; Prof. Moise Ascoli, president of the Associazione Electtrotecnica Italiana, and B. J. Arnold, president of the American Institute of Electrical Engineers.

In the afternoon the delegates were the guests of honor at a reception given by the Chancellor and Governors of McGill University. They assembled at the Engineering building at 4.30 and were received in the drawing room by Mr. and Mrs. Frank Redpath, Mrs. C. J. Fleet and Prof. Owens. The electrical and engineering departments were visited and were the subject of very favorable comment. In the evening a garden party was given on the grounds of the Forest and Stream Club at Dorval. In addition to the usual attractions of such an occasion, a special feature was introduced by way of showing the delegates a little in the way of Indian life. Canoes were equipped with Indians in war attire, who disported themselves in true Indian war fashion round the bend of the river, then landed and gave all the realities of a war dance and spirit dance and performed an Indian marriage ceremony, completing their entertainment by singing "God Save the King" in their native tongue.

A special train furnished by the courtesy of the Great Northern Railway Company took the party to Shawinigan Falls on Thursday morning. Luncheon was served by the Shawinigan Water & Power Company promptly on arrival at Shawinigan, after which an inspection was made of the numerous electrical developments. The delegates were greatly interested in the hydraulic and electrical installations and the trip was thoroughly enjoyed and appreciated. The return trip to Montreal was made in two hours, the company giving the special train a through right of way, which permitted of the party spending more time at the falls. Montreal was reached early in the evening and at 9 p.m. the party took the C.P.R. train at the Windsor street station for Niagara Falls, where the power development works in operation and under way at that place were inspected.

Much credit is due the local reception committee at Montreal for the complete arrangements for the entertainment and comfort of the visiting engineers. This committee was composed of R. B. Owens, D.Sc., chairman; Henry D. Bayne, general secretary; J. E. Aldred, W. F. Angus, W. R. Baker, J. A. Baylis, F. E. Barbour, K. W. Blackwell, H. T. Bovey, H. A. Burson, W. A. Duff, W. F. Dean, Alfred Collyer, E. A. Evans, P. G. Gossler, H. S. Holt, L. A. Herdt, George Janin, C. A. Johnson, Wallace C. Johnson, John Kennedy, R. S. Kelsch, Edgar McDougall, C. H. McLeod, J. M. McCarthy, Frank W. Morse, R. D. Mershon, Ernest Marceau, Wm. Peterson, F. R. Redpath, Hazen Ritchie, R. A. Ross, W. G. Ross, E. F. Sise, W. McLea Walbank, R. M. Wilson.

PERSONAL.

Mr. A. J. Bemis has been appointed to succeed Mr. E. S. Dimmock as general manager of the Cape Breton Electric Company, of Sydney, N.S.

Mr. A. McFail, a graduate of McGill University, Montreal, has been appointed professor of general engineering in the School of Mining, Kingston, Ont.

Mr. J. F. H. Wyse, formerly manager of the Brantford Electric and Operating Company, is now practising as a consulting electrical engineer. His office is at 16 King street west, Toronto.

The efficient services of Mr. T. H. McCauley, superintendent of the railway and light department of the town of Port Arthur, Ont., have been recognized by the Commissioners by an increase of $50 per month in his salary.

Mr. O. Higman, chief of the electrical branch of the Inland Revenue Department, Ottawa, represented the Canadian Government at the International Electrical Congress held at St. Louis, Mo., last month.

Mr. N. Grayburn has been appointed master mechanic for the Montreal Street Railway Company and will have charge of the mechanical and winding shops. Mr. D. Blair has been appointed superintendent of rolling stock.

Mr. John Henning, who died in Toronto last month, in his ninety-fifth year, was associated with the construction of the first street railway in Toronto. Afterwards he obtained a Government position on the Welland canal, living at St. Catharines.

Mr. T. G. Coursolles, president of the Stratford-St. Joseph Electric Railway Company, dropped dead at his home, 262 Laurier ave., Ottawa, on September 10th last. He was seventy-two years of age and until two years ago was Chief Translator at the House of Commons.

FEATURES OF THE SHAWINIGAN PLANT.

Mr. Wallace C. Johnson, Mem. Amer. Soc. C. E., contributes to the Montreal Electrical Hand-Book a very interesting article describing the power plant and transmission line of the Shawinigan Water and Power Company, of Shawinigan Falls, Que. One of the features of this plant is a device designed by Mr. Ralph D. Mershon, consulting electrical engineer for the company, for protection against possible explosions or fire in the transformer room. This device Mr. Mershon describes as follows :

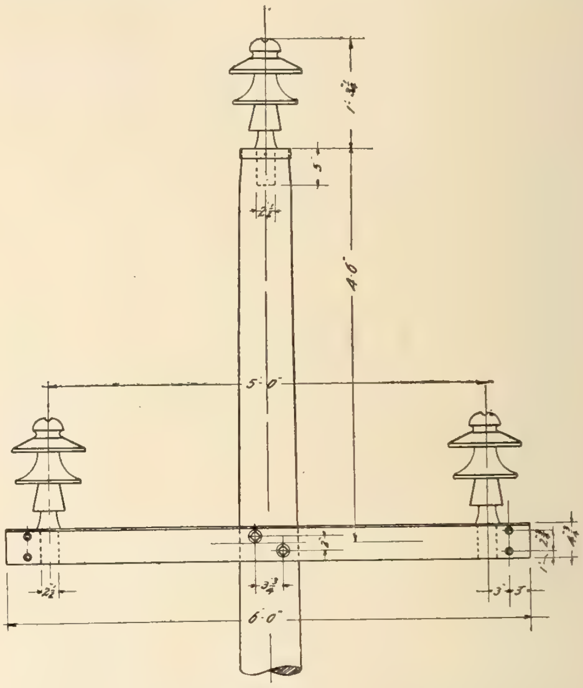
"To the center of the lid of each transformer tank is connected a large pipe leading to the sewer. At the bottom of the tank is another pipe connected to the source of water supply and closed by two valves in series, between which is a small drip cock to prevent the possibility of water entering the transformer tank through a leaky valve. The lid of the tank is fitted carefully to the tank itself with gaskets, and all conductors passing through the lid are brought out through stuffing-boxes so that the tank is practically air-tight, except as regards the vent from the middle of the lid through the pipe into the sewer. The tank and all its fittings are built to stand the maximum pressure which could be generated by ignition of any mixture of air and oil vapor which might collect over the surface of the oil. The tank itself is, therefore, strong enough to stand the force of an explosion, and, in addition, there is the vent from the top to the sewer to relieve and keep down the pressure of any explosion which might occur.

"If, after trouble in the transformer, the oil should continue to burn, making it desirable to get the oil out of the tank, the water valves at the bottom of the tank may be opened, thus admitting water to the tank and forcing the oil out of the top into the sewer. This is a much safer way of emptying the tank than by the usual means of a valve at the bottom, since in the latter case air must be drawn into the tank as the oil passes out, making possible the formation of an explosive mixture and risking the danger of an explosion. Even if the oil were not burning, there is more or less danger in drawing it out of the bottom of the tank, since the explosive mixture formed thereby would be ignited by any smouldering bits of insulation which might be present.

"The use of the water would not be resorted to except in an extremity, but it is believed to furnish in case of such extremity a safeguard much more effective than anything else which has been proposed. If the water be used, it will not necessarily do any great damage to the transformer, especially if it be not allowed to remain long in the transformer tank. An oil soaked transformer will not readily take up water, and such water as it does take up can be dried out. The transformers in most cases will have to be dismantled for repairs, and the dismantling will make the drying out more easily and quickly accomplished. With the transformers installed in the manner described, it is believed that no serious damage could result from either an explosion or fire."

The transmission line also embodies some interesting features which are described in the Electrical Hand-Book. The length of the line from the generating station at Shawinigan Falls to the terminal station in Montreal is 84.3 miles. It consists of three aluminimum cables, each composed of seven No. 7 aluminimum wires. The total drop in the transmission line when 8,000 horse power are being delivered to the customers' bus-bars in Montreal is, at unity power factor, about 18 per cent. of the delivered voltage, requiring about 50,000 at the generating station. By operating at a higher drop, considerably more power may be transmitted over the line, and it is possible to do this with the present installation since the step-up transformers are capable of operating at considerably over their rated voltage.

The three line cables are arranged in an equilateral triangle, the distance from centre to centre of cables being 60 inches. One of the cables is carried on top of the pole and the other two at the end of a cross-arm. The insulators were specially designed for this plant and this voltage. Before shipment all of them were given a salt water test of 100,000 volts for one minute. They are of porcelain, and are in three parts, held together by Portland cement. The poles are of cedar, and are set generally 100 feet apart, although where necessary the span has been increased to 200 feet. Each pole is bored in the top for the top pin, and the top of the pole is surrounded by an iron band driven tightly on to prevent splitting. The cross-arms are of southern pine, treated by dipping in a hot, weather-proof, and preserving mixture. The pins are of hickory, treated by boiling in stearic acid.



POLE HEAD OF THE SHAWINIGAN TRANSMISSION LINE.

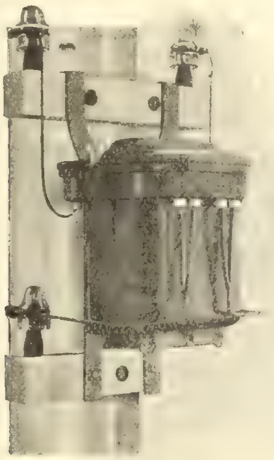
The transmission line is transposed at two points at approximately ⅓ and ⅔ of the total distance. It was constructed with a telephone line on the same poles, which has operated successfully except that in cases of accident resulting in the dropping of one of the transmission lines, the telephone line is usually destroyed at the time it is most needed. It has, therefore, been decided to remove the telephone line and build same on a separate pole line.

A second transmission line is now being constructed, similar to the one described, except that the cables will be composed of seven strands of No. 4 wire.

The heating system of the asylum at Brandon, Man., is to be remodelled. A new boiler house, with a smoke stack 80 feet high, will be erected.

TYPE "H" TRANSFORMERS.

The merits of Type "H" oil transformers as manufactured by the Canadian General Electric Company are enumerated in an attractive booklet recently issued by that company, the cover of which is exceptionally artistic. It is pointed out that these transformers have high insulation, low core loss, good regulation and low and uniform temperature rise, features which are of much importance in central station practice. High insulation means safety to customers, few burn-outs and interruptions in service, low maintenance cost and small depreciation, and as Type "H" transformers are insulated to withstand, without oil, a 10,000 volt test between the primary and secondary, the above results would seem assured. The advantage of low core loss is small coal expense for magnetizing the cores of transformers, while good regulation permits the use of high efficiency lamps and gives uniform light and low cost for lamp renewals. Low temperature rise prevents aging (or increase of core loss,) burn-outs, deterioration of insulation and shortening of life. Aging is reduced to a minimum by the use of specially treated sheet steel for cores and by designing Type "H" transformers for low and uniform temperatures.


Type "H" Transformer, Mounted.

The following advice is given in the booklet on the question of grounding the secondaries of transformers:

Grounding of the secondaries of Type "H" transformers has been approved by the American Institute of Electrical Engineers and the National Electric Light Association. The National Board of Fire Underwriters has incorporated in the National Electric Code a rule covering this matter. To insure good service with a grounded secondary, superior insulation between the primary and secondary is necessary, for the reason that, under these conditions, only one ground, i.e., one on the primary, is sufficient to put a strain of the full potential of the primary circuit on the insulation between primary and secondary coils, whereas ordinarily it is necessary to obtain an accidental ground on both primary and secondary. The Canadian General Electric Company recommends the grounding of the secondary rather than the use of a grounded shield, for the reason that while the shield might prevent primary voltage appearing on the secondary by breaking down the insulation between coils, there would be no protection if a cross should occur outside of the transformer. On the other hand, if the secondary circuit were intentionally grounded, it would be impossible to obtain a difference of potential between the house wiring and the ground greater than the lamp voltage.

Section Through Type "H" Transformer.

SPARKS.

The Western General Electric Company, Limited, was incorporated at Regina, N. W. T., on September 1st last.

The London Street Railway Company, London, Ont., have commenced the erection of new barns which will cost about $12,000. McBride & Farncombe prepared the plans.

The Council of Westmount, Que., have passed a resolution authorizing the submission of a by-law to the ratepayers to raise $225,000 for the installation of a combined garbage plant and electric light station.

The second annual field day of the employees of the Canadian General Electric Company at Peterboro was held on September 17th. An interesting programme had been arranged and the events were keenly contested. One of the features was a five mile race between Messrs. Burns and Payne, which was won by the former.

Mr. John Galt, C.E. & M.E., of Toronto, has reported that waterworks and electric light systems for the town of Indian Head, N.W.T., would cost about $87,000. The E. S. Harrison Company, of Winnipeg, have submitted a proposition to establish an electric plant at that place, and sentiment seems to be in favor of accepting their offer.

Mr. W. H. Noble, of the Department of Marine and Fisheries, Ottawa, has just installed on a lighthouse now being constructed on Lennard Island, on the west coast of Vancouver Island, what is claimed to be the most powerful light in Canada. It will give a beam of light having a candle power of 750,000, and under favorable weather conditions can be seen a distance of twenty-five miles. With the exception of the electric light formerly in operation on the Sibert statue on Bedloe's Island, New York harbor, the new Lennard Island light will be the most powerful in America.

The Master Painters' and Decorators' Association of St. John, N. B., have written the St. John Street Railway Company and the New Brunswick Telephone Company regarding the inconvenient way in which some of the wires of these companies are placed on buildings, making it costly to property owners and master painters as well as a source of danger to workmen in the building trades. In some cases the wires are run from poles to buildings part way up, thus interfering with the hoisting of scaffolds, signs, etc., whereas it is claimed that these wires could be run to the top of the building and then brought down to any desired place. The city council will be requested to look into the matter.

At the semi-annual meeting of the New England Cotton Manufacturers' Association, held at Bretton Woods, N. H., September 21 and 22, the following were among the papers read: "Electricity in Textile Mills," by Charles Robbins, of New York; "Electric Measurements of Power Required in Cotton Manufacture," by Edward W. Thomas, of Columbia, N. C.; "Test of a 400 K.W. Parsons Turbine," by George I. Rockwood, Worcester, Mass.; "Automatic Feed Water Regulators and Low Water Alarms for Boilers" by John Oldfield, of Boston, Mass. Mr. Robbins stated that there are now in operation in textile mills electric motors aggregating in capacity 140,000 h. p. It will therefore be seen that in view of the comparatively recent introduction of the electric motor in this industry, it is making rapid strides as a means of power transmission.

Owing to the adoption of electricity throughout the entire works of the Canadian Pacific Railway at Fort William, Ont., the operation of elevator A has been entirely changed. Foreman Morrison has recently been busily engaged testing the new machinery and perfecting the alignment of the shafting. The nine receiving legs of the elevator are divided into three units, each controlled by separate motors, which arrangement also prevails on the shipping side, while independent motors operate the winch and dust collecting apparatus. There is required for the operation of this elevator 900 horse power, or 675 kilowatts. As the present capacity of the C.P.R. power house is only 1,000 kilowatts, steps are being taken to install two new generators, one of 1,000 k. w. for power, and one of 400 k. w. for lighting. Power will be required for the machine shops and round house and to operate elevators A, E, and B, the latter elevator being now near completion. It is understood that turbine engines will be installed.

TELEGRAPH and TELEPHONE

TELEGRAPH VERSUS TELEPHONE.

It is quite apparent that the telephone is invading the field of the telegraph, and the question is being asked "Is the Telegraph Doomed"? Figures for the telegraph service show that in 1903 nearly 365,000,000 messages were sent in all countries, an average of about a million messages a day. Great Britain is credited with the sending of 92,471,000 messages, and the United States comes second with 91,391,000 messages. In 1902, for which the telephones statistics are available, the number of messages transmitted in the United States alone was more than 5,000,000,000.

Some particulars of the growth of the telephone in England is found in the fiftieth annual report of the Postmaster-General. The total number of trunk line conversations during the year was 13,467,975, the corresponding figures for the preceding year being 11,574,229, the increase for the year being 16.3 per cent. The gross revenue from this service was $1,627,625, an increase of 18.4 per cent. over the preceeding year. The total length of trunk circuits in use at the end of March, 1904, was 51,004 miles, containing 102,800 miles of wire.

The report makes note of the intercommunicating system established in London last year, in which a switchboard of a similar character to a multiple telephone switchboard is used for directly connecting together the various offices in the London area. This cuts out a re-transmission at the central office and much improves the London telegraph service. Between 3,000 and 4,000 telegrams pass daily between the offices connected in this manner. This figure is of interest when it is considered that the daily telephone traffic of London must be about 120 times as much.

SHORT-CIRCUITS.

A new telephone system is being installed at Rossland, B. C.

The Nova Scotia Telephone Company are building a brick and stone exchange at New Glasgow, N. S.

Messrs. D. V. Mott and A. J. Mott have been granted a franchise to install a telephone system at Fernie, B. C.

The Grand Trunk Railway have constructed a telephone line between Palmerston, Owen Sound and Wiarton, which is also used for telegraphing.

The invitation extended to telephone companies by the City of Toronto to tender for the privilege of installing a telephone system did not produce great results, as only one tender was received.

The Bell Telephone Company are completing a large addition to their main offices at the corner of St. John and Notre Dame streets, Montreal. The switchboard to be installed will have a capacity for 10,000 subscribers.

The Western Telephone Company have built a power house at Red Deer, N. W. T., with the object of furnishing electric light and telephone systems for that place. They may also furnish the power for operating the waterworks system.

A Danish electrical engineer has invented an attachment for the telephone by which messages received during the absence of the subscriber from his office can be recorded and reproduced at desire. The new instrument is called the telegraphone.

Toronto City Council, by a vote of nine to four, adopted the report of a special committee favoring a municipal telephone system and decided to submit to the ratepayers at the January election a by-law to raise $40,000 for the installation of such a system.

It is said that Signor Marconi is expected at Glace Bay, N.S., shortly, for the purpose of testing some new appliances now being installed to increase the power of the station. He will probably make an attempt to effect communication between Table Head and the station in Italy.

The Pacific Wireless Telegraph Company have opened for business at Victoria, B.C. Their station is at the Driard Hotel. The aerial mast is some 150 feet high and is rigged out in modern style. The company have stations at several points on the Pacific coast and expect to install a station at Seattle, Wash., in the near future.

The Bell Telephone Company have completed the construction of a long distance line from Morris to Emerson, Man. It is proposed to construct also a service for farmers extending to Ridgeville, about ten miles east of Emerson, and to connect with the American Telephone Company at Pembina and St. Vincent.

The Ontario Independent Telephone Company, Limited, has been incorporated by the Ontario Government, to construct and operate telephone systems in municipalities. The company is capitalized at $100,000 and has its headquarters at Windsor, Ont. Messrs. C. W. Taylor and J. R. Brooks, of Detroit, are among the promoters.

The contract was let on October 5th for the erection of a new Marconi wireless telegraph station near Port Morien, about four miles from Glace Bay, N.S. The contract calls for the dismantling of the present towers at Table Head and the erection of a new one of the same height, 215 feet, and the removal of the operating room and power house to the new location. The station is to be completed by the first of the year.

The largest station for wireless telegraphy yet erected has just been completed at Pisa, Italy. The buildings are entirely of stone. The station is called Coltano. It is designed to establish wireless telegraphic communication from there with Great Britain, Holland, the United States and Canada, as also with vessels in the Mediterranean, the Baltic Sea, the Red Sea and the Atlantic and Indian oceans. Lately two Marconi stations have also been completed on the coast of Montenegro, and are now in working order.

When the first electric telegraph was established, according to the British postmaster general, the speed of transmission was from four to five words a minute on the five-needle instruments. In 1849 the average rate for a number of newspaper messages was seventeen words a minute. The present pace of the electric telegraph between London and Dublin, where the Wheatstone automatic instrument is employed, reaches 500 words a minute; and thus what was regarded as miraculous sixty years ago has been multiplied a hunderedfold in one-half century.

The annual general meeting of the shareholders of the Great North-Western Telegraph Company was held in Toronto on September 27th, when the following directors and officials were re-elected: President, H. P. Dwight; vice-president, Adam Brown; 2nd vice-president and general manager, L. McMichael; directors, James Hedley, W. C. Matthews, H. N. Baird, Toronto; Hon. William McDougall, Ottawa; Col. R. C. Clowry, J. B. Van Every, New York; secretary-treasurer, George D. Perry; auditor, A. C. McConnell.

The members of the City Council of Brantford are still undecided as to the wisdom of establishing a municipal telephone system. The by-law recently passed for that purpose has been withdrawn and the question left open till October 17th. In the meantime offers will be received from independent companies. The Stark Telephone & Power Company, of Toronto, have offered to supply business telephones for $25 per year, residence telephones for $12, and ten telephones for city use free, and to pay $700 annually for the franchise.

The Canadian Pacific Railway Company have been experimenting for some time with a train telephone. Each baggage car and each van is equipped with a telephone, a long wire and a pole with a hook, which is simply hooked on to the telegraph wire at any point and the dispatcher's office at Montreal can be communicated with instantly without interfering with the wire being used in telegraphing. The great advantage will be that in case of trouble the train men can communicate with the dispatcher and he can not only protect but send assistance promptly to the train in trouble. One division of the company's line will be equipped at the outset, when, if found satisfactory, the equipment of additional sections may follow.

COST OF ORILLIA'S POWER PLANT.

The Orillia Times gives a detailed statement of the cost of the power plant constructed by that town, preceded by the following summary : "C. E. Grant, the town treasurer, has prepared a statement of expenditures in connection with the power plant since its inceeption in 1898 up to the present time, a total of $122,956.04 up to December 31 last, and $36,605.05 since that date. A noteworthy fact is that $22,677.07 has been expended this year in new machinery for the permanent enlargement of the plant, giving double the horse power what the town had before the dam went out. It will be seen that the amount spent and liabilities incurred in an endeavor to repair the break in the dam is $9,496.73. This is not all loss, as a good deal of the material, such as lumber, etc., can be utilized in the construction of the new dam, and there is a balance of over $13,000 towards the expenditures of $25,000, the cost of the contract.

To the total figures here given may be added the amount of the Patriarche award, say $38,000, $28,000 for construction of the timber dam now being built, and say $10,000 for repairs to the permanent dam, and the whole sum will show the town's investment for the development of eighteen hundred horse power, with an auxiliary steam plant of 450 h. p., electric pump, etc., a sum in round figures of $255,000. This investment, it is presumed, will net the town a profit of $10,000 yearly."

TRADE NOTES.

The Syracuse Smelting Works, of Montreal, advise that they are always open to purchase lead or copper concentrates.

The Rossendale Belting Company, Limited, of Manchester, Eng., have been granted a license to carry on business in Ontario as manufacturers of and dealers in belting, mill supplies, etc.

The Doty Engine Works Company, Limited, has been incorporated at Goderich, Ont., with a capital of $40,000, to manufacture engines, boilers, etc. The directors include Messrs. F. W. Doty and C. W. Doty.

The Northern Aluminum Company, of Shawinigan Falls, Que., have secured from the Department of Railways and Canals, Ottawa, a contract to supply the conductors for the electric transmission and distribution circuits of the Welland Canal.

The Simplex Coal Saver, Limited, has been incorporated, with head office in Toronto, to manufacture and deal in fuel savers, smoke consumers, and engineers' supplies. The directors of the company are Messrs. P. H. Patriarche, F. B. Allan and William Eacrett.

Incorporation has been granted to the Crown Oil Company, Limited, of London, Ont., to carry on the operations of a mining, milling, reduction and development company. The share capital is $300,000, and the promoters include Messrs. D. S. Robb and B. G. Baker.

The Goldie & McCulloch Company have just furnished the Winnipeg Street Railway Company with a compound engine of the heavy duty type, the fly wheel of which weighs 109,940 pounds. This type of engine has been specially designed to meet the requirements of modern central station practice.

Foxcroft & Duncan, Queen's Road, Dalston, London, N. E., England, manufacturers of a general line of measuring instruments, switch and distributing boards, main switches and fuses, carbons, globes, etc., propose to establish an agency in Canada and invite correspondence from firms desirous of handling their goods in this market.

Messrs. W. T. Glover & Company, of Manchester, Eng., advise us that they have just been awarded a contract amounting to over $500,000 for electric light and power cables for the municipality of Johannesburg, South Africa. The contract includes the supplying and laying of Diatrene paper insulated lead covered cables, Diatrene paper leadless cables, and vulcanized rubber cables, the high tension mains being for 3,000 volts working pressure. The cables, together with joint boxes and accessories, will be manufactured at their Trafford Park Works, Manchester.

The Canadian Westinghouse Company, Limited, of Hamilton, Ont., have opened offices in Winnipeg, Man. The offices are located in the Union Bank Building. The representative in charge of the district covered by this office is Mr. W. E. Skinner, who was formerly associated with the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa.

Some time ago we mentioned that experiments were being made regarding the production of ingot copper and bronze by the Syracuse Smelting Works, of Montreal. Since that time we understand the work has steadily proceeded and that recently a company has been incorporated to prosecute this industry entirely. It is to be called the Montreal Copper Company, Limited, and will be devoted to the production of ingot copper, phosphor copper, and phosphor bronze ingots. It is interesting to note that this is the first company of its kind in Canada, all copper mined in Canada and smelted into "Math" being usually sent to the United States to be refined. The company at the present time have a capacity of eight tons per day, which has proved quite inadequate for the demand. The object of the recent corporation is to provide the necessary capital for materially increasing the capacity. The officers are : Mr. H. Sapery, president; Mr. L. Sapery, manager ; Mr. Fritz Bornholdz, secretary-treasurer. The company was incorporated with a capital of $150,000, but it is intended to increase it to $250,000.

SPARKS.

The Ontario Traction Company expect to commence work very shortly on their electric road from Windsor to Tecumseh, Ont.

The electric light plant at North Bay, Ont., has been purchased by a syndicate represented by Mr. A. F. Leggatt, president of the North Bay Gas Company.

The Shawinigan Water and Power Company have notified the Montreal Light, Heat and Power Company that they will be prepared on December 1 next to deliver 10,000 additional horse power at Montreal.

An engine operating as a steam engine with a mixture of alcohol and water, previously evaporated under pressure, and exhausting a combustible in the shape of the alcohol, which burned can be utilized to make more steam, was suggested at a recent meeting of the German Physical Society by Mr. Friedenthal, who exhibited a working model.

The attorney general at Quebec has instituted an action against the Montreal Light, Heat and Power Company and the Montreal and St. Lawrence Light, Heat and Power Company for $20,000 damages for the destruction of the Yule bridge over the Richelieu river during the break-up of the ice on April first last. The Yule bridge is a toll bridge across the Richelieu river between the counties of Chambly and Richelieu, and during the floods last spring both it and the Vermont Central Railway bridge were carried away by the ice. The provincial authorities claim that the damage was caused by the power dams of the defendant companies situate about 800 feet above the Yule bridge, which so raised the level of the water as to precipitate the ice against the abutments of the bridge.

It is understood that the Huronian Company, which has been organized by interests identical to those of the International Nickel Company, New York, intend installing a large plant at Turbine, Ont., for the purpose of generating power for transmission to the Canadian Copper Co.'s smelters at Copper Cliff, 30 miles distant. The initial capacity of the plant will be 6,000 h.p. The contract for the generators has been awarded to the Crocker-Wheeler Company, and calls for two 2,000 k.w. 400 r.p.m. alternating current generators of the type manufactured by the Swiss electrical engineering firm of Brown, Boverie & Cie, of Baden. The Crocker-Wheeler Company have secured the American rights for the Swiss company's alternating-current machinery. The contract for turbines has not yet been awarded. The plant will be installed under the supervision of Messrs. Ross & Holgate, consulting engineers, Montreal. The Canadian Copper Company, it is stated, will install a number of large motors.

REMOVAL NOTICE.

On the first of November, 1904, the Winnipeg office of this Journal will be removed to Rooms 720 and 721 of the new Union Bank Building. This building, which is just nearing completion, is thoroughly fireproof and in construction and equipment is the equal of any on the continent.

A standing invitation is given readers and friends of the Journal to call when in Winnipeg. Any possible information or assistance will be gladly furnished them.

SPARKS.

The dissolution is announced of Collyer & Brock, electrical contractors, Montreal.

Mr. Boyce, of Portage la Prairie, is negotiating for the establishment of an electric light plant at Carberry, Man.

The ratepayers of Streetsville, Ont., last month defeated a by-law to provide $3,000 for the installation of an electric light plant.

Mr. George Alexander purposes installing an electric plant at Kaslo, B.C., that municipality having granted him exemption from taxation for seven years.

The power house of the Grand Valley Railway Company at Blue Lake, Ont., is practically completed, and from it power will be obtained to operate the Grand Valley electric railway.

A new electric light station for the Intercolonial Railway system at Halifax, N.S., will be put in operation within a month. It is located east of the passenger station. The plant is intended to light the terminal sheds, wharves and yard, the local freight shed, North street passenger station and Richmond wharves, offices, round-house and machine shops.

The Mexican Light & Power Company, which is controlled by Toronto and Montreal capitalists, have secured a contract from the Federal Government of Mexico for the entire lighting of the city of Mexico and suburbs till 1917, also for the lighting of the post offices and Government building in that city. The contracts were arranged by Mr. C. H. Cahan, of Halifax, attorney for the company.

The Electric Development and Securities Company, incorporated under the laws of the State of New York, has been granted a license to conduct business in Ontario, under the name of the International Electric Securities Company. Authority is given to develop power and to carry on a general contracting business. Mr. F. K. Foster, of Toronto, has been appointed attorney for the company.

The British Columbia Electric Railway Company will next spring commence the erection of a large office building and terminal station at the corner of Carrall and Hastings streets, Vancouver. It will be three stories and of the most substantial construction. Provision will be made for handling freight with all possible dispatch and a new arrangement of tracks and switches will afford greater convenience for passenger traffic. The company also propose to extend the gas plant, which they recently acquired.

The Victoria Power Company, Limited, of Victoria, B.C., have submitted the plans of their proposed scheme to the Government. The company propose to take 7,000 miner's inches of water from Shawinigan lake, Vancouver Island, and 5,000 miner's inches from the Koksilah river, to be conveyed by pipes to a power house on Mill Bay, where an electric plant is to be installed. The power will be utilized to supply chiefly the British Columbia Electric Railway Company, but it is also proposed to furnish power to Victoria, Esquimalt, Oak Bay, and adjacent points for manufacturing and industrial purposes.

ELECTRICAL REPAIRS

In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

MESSRS. FRED. THOMSON & CO.
774 Craig Street, MONTREAL, P.Q.

have arranged their works for repair work only. They keep armatures of nearly all makes of dynamos in stock, which they loan while repairs are being made. The factory is so arranged that they can run night and day, and work can be finished in the shortest possible time. Telephone Main 3149.

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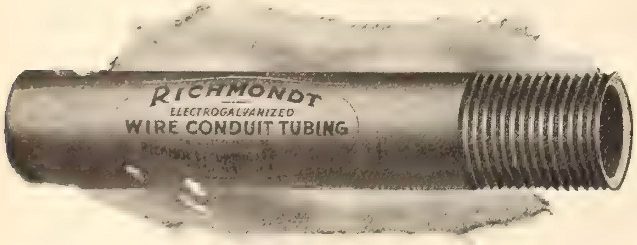
For Absolute Safety in Interior Wiring.



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WM. S. ALDRICH, Director

NEW TELEPHONE DIRECTORY

The Bell Telephone Co. of Canada, Limited
will issue a new
Subscriber's Directory
for the
District of Toronto
About the 15th of October, 1904.

Orders for new connections, changes of firm names or addresses should be sent in before the 1st of October to insure their appearance in this book.

K. J. DUNSTAN,
Local Manager.

Toronto, Sept. 15th, 1904.

American Circular Loom Company's AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED FLEXIBLE CONDUIT

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Instant shipment made. Large stock of all sizes always on hand.

PUBLICATIONS.

The McGraw Publishing Company, 114 Liberty Street, New York, have just published "Maxwell's Theory and Wireless Telegraphy." Part one comprises "Maxwell's Theory and Hertzian Oscillations," by H. Poincare, translated by Frederick K. Vreeland, who is the author of part two, devoted to the principles of wireless telegraphy. The book is so written that the reader is enabled to obtain a practical understanding of the essentials of wireless telegraphy, mathematics and abstruse reasoning being purposely avoided. Retail price, $2.

An attractive and instructive hand-book has been issued by the Montreal Reception Committee appointed to receive the delegates to the International Electrical Congress at St. Louis, on their visit to Montreal. The book is titled "The Montreal Electrical Hand-Book." It is replete with information concerning the electrical works of the districts round, and contains numerous illustrations. The price charged is $1.00 per volume, of which there are but a limited supply. It can be obtained by remitting direct to Mr. W. A. Duff, Canadian Westinghouse Company, Limited, Montreal, Que.

The City Council of St. John, N.B., have decided to purchase the Carleton electric light plant. It is probable that the city will build a new station and make improvements to the plant.

SPARKS.

The Department of Railways and Canals, Ottawa, recently invited tenders for electric lighting of the Carillon and Grenville canals.

Mr. J. A. M. Aikins, K. C., representing the Keewatin Power Company, and Mr. Phippen, K. C., representing the Hudson's Bay Company, recently appeared before Judge Chapple at Rat Portage, Ont., in the matter of appointing another arbitrator to settle the dispute between the town and the above mentioned parties as to who shall utilize the water power at Rat Portage. The Hudson's Bay Company claim the land on the north side and the Keewatin Power Company that on the south side of the falls, while the town claims the right to the power.

The Stave Lake Power Company recently decided to issue debenture bonds to the amount of $900,000 for the purpose of securing funds with which to develop the company's power at the Stave River falls, below Stave Lake, B.C. It is reported that Eastern capitalists have agreed to take the bonds. It is the intention of the company to proceed with the development work as soon as possible, probably this fall. The power may be utilized for the operation of trains of the V. W. & Y. Railway and the Great Northern branch line from Cloverdale to Port Guichon, on the Fraser river, and to supply light and power in Vancouver and New Westminster. Stave Lake Falls are about thirty-six miles from Vancouver and it is estimated that they are capable of producing 25,000 horse power.

Mr. C. Hetherington, of Galt, Ont., has invented a rotary compound engine and is said to be now making arrangements for its manufacture in Canada.

The ratepayers of Seaforth, Ont., last month voted in favor of issuing debentures to the amount of $19,300 for the purpose of purchasing the existing light plant.

The Toronto & Niagara Power Company have placed an order for four turbines for their power house at Niagara Falls, Ont., with the I. P. Morris Company, of Philadelphia, Pa. Each of these turbines will be of 10,000 horse power capacity. The company last month awarded the contracts for the erection of their distributing station on Davenport road, just outside the limits of Toronto.

WE HAVE FOR SALE THE FOLLOWING MACHINERY

And will receive tenders for same up to OCTOBER 15th, subject to previous sale :—

1 18"x42" Wheelock Engine.
1 72"x20' Leonard Boiler.
1 165 H. P. Babcock & Wilcox.
1 600 H. P. Moffatt Heater.
1 Northey Duplex Steam Pump, 6"x6" and 4"x6".
1 Goldie & McCulloch Double Plunger Belt-driven Pump.
1 Vertical Engine, 6"x7", high-speed automatic cut-out.
1 Horizontal Engine, 8"x10", high-speed automatic cut-out, new 50' of 4" shafting.
8 Floor Stands.
8 Bearings.
1 26" Clutch, Goldie & McCulloch.
1 20" Clutch.
2 40"x12" Iron Pulleys.
4 6"x60" Iron Pulleys.
1 39"x24" Iron Pulleys.
1 48"x24" Iron Pulleys.

ELECTRICAL MACHINERY

1 100 K. W. Edison Bi-polar Direct Current Railway Generator.
1 spare Armature for same.
1 50-light 3 amp. New York Ball Arc Dynamo.
1 50-light 4 amp. New York Ball Arc Dynamo.
50 3 amp. Enclosed Arc Lamps.
50 4 do do.
2 Ball Arc Regulators.
1 75 K. W. Royal Induction Alternator.
1 3 K W Exciter.
1 50x60 2" Marble Panel Switchboard, with 3 Weston instruments, station transformer and rheostat complete.

TRANSFORMERS

7 20 light.
10 30 do
15 40 do.
1 250 do.
1 350 do.
1 450 do.
About 300' 6" and 8" steam pipe.

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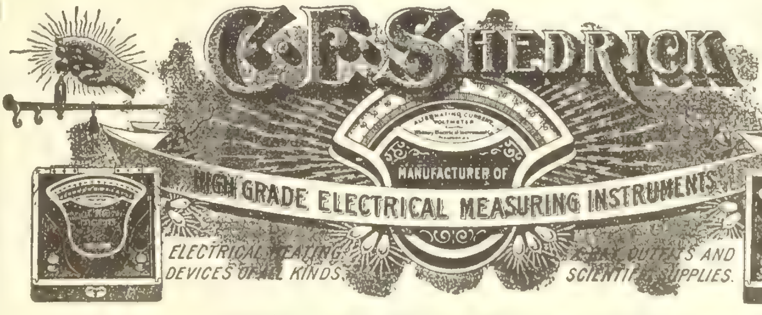

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as illustrated is a handsome instrument, perfect in construction and design, with no exposed contacts or wires, and has many other points of advantage.

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SPARKS.

The Board of Trade of Galt, Ont., have passed a resolution in favor of installing an electric fire alarm system in that town.

The Peterboro Radial Railway Company inaugurated a street car service in Peterboro, Ont., on August 29th. The road has been practically rebuilt and one and one-half miles of additional track constructed.

The electric railway from London to St. Thomas, Ont., is now almost completed and the power house will be erected at once. Judging from present appearances the road will be in operation in the early part of 1905.

The new electric power plant for the Intercolonial Railway at Moncton, N. B., is almost completed. The building is 99 by 47 feet and is divided into two rooms, the boiler house and the generator room. The plant includes two 105 k.w. direct connected three-phase alternators, marble switchboards, etc.

Messrs. Marchand & Company, electrical contractors, of Ottawa, are said to have acquired an interest in a water power at Bryson, Que., and to have in contemplation a scheme to supply light and power to Bryson and the adjacent villages.

The new store and workshops of the Hinton Electric Company at Victoria, B.C., were formally opened on August 22nd last. The building runs from Government to Broad streets, is 110 × 22 feet with basement, the show-room being on the ground floor and the workshop over-head. Some 400 lights of all shades were burning brightly, and the visitors concluded that a more complete and up-to-date electric supply house was not to be found in Canada.

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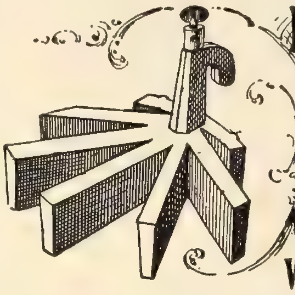

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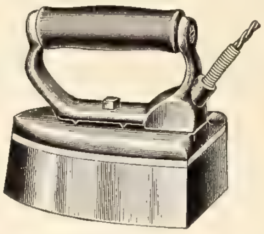

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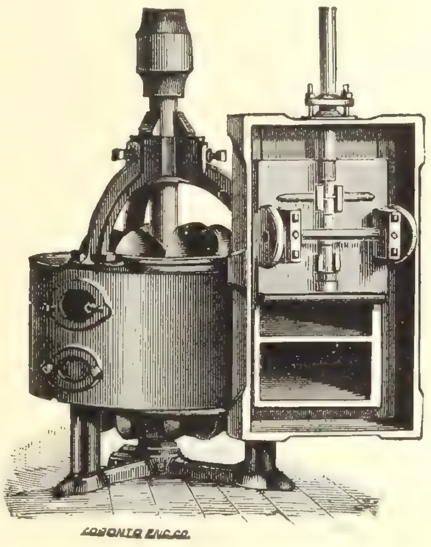

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SPARKS.

The Royal City Mills, New Westminster, B. C., are building a new boiler house in connection with their saw and planing mill.

Messrs. W. Moore & Sons, who are developing a water power near Midland, Ont., expect to have their plant completed about the 1st of December.

Mr. John D. Macdonald has installed an electric plant at the Bankside collieries at Banff, N.W.T., the plant being furnished by the Canadian General Electric Company.

The Quebec Railway, Light & Power Company, of Quebec, held their annual meeting last month. The financial statement showed an increase in net earnings of $17,426.47. Mr. A. Thomson was re-elected president and Mr. A. E. Evans general manager and chief engineer.

The International Railway Company has been granted a license as an extra-provincial company to carry on business in Ontario and to acquire all the rights granted to the Niagara Falls Park and River Railway.

A lease of the water power at Baker Brook has been granted by the New Brunswick Government to the Baker Brook Manufacturing Company. This company was organized by Donald Fraser & Sons, of Fredericton, and it is understood that the intention is to build a large saw mill and utilize the water power.

Mr. W. Meredith, consulting engineer of the Vancouver Power Company, has been looking into the possibility of operating the electric plant at Vernon, B. C., by water power. Several available powers are being examined.

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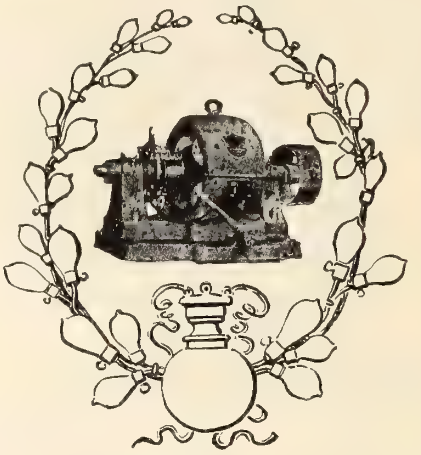

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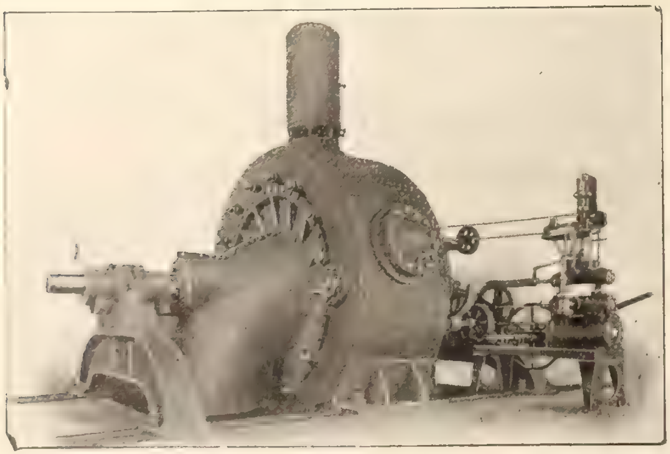

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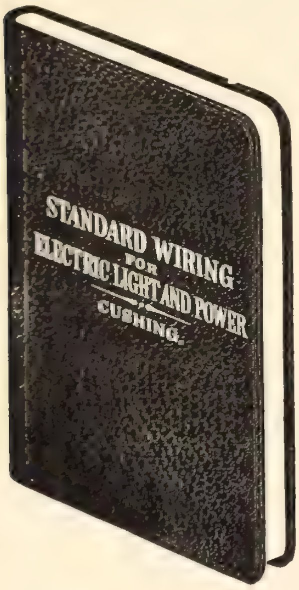

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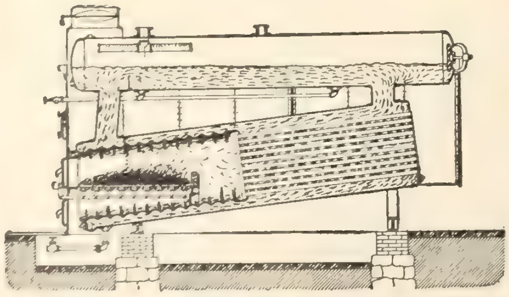

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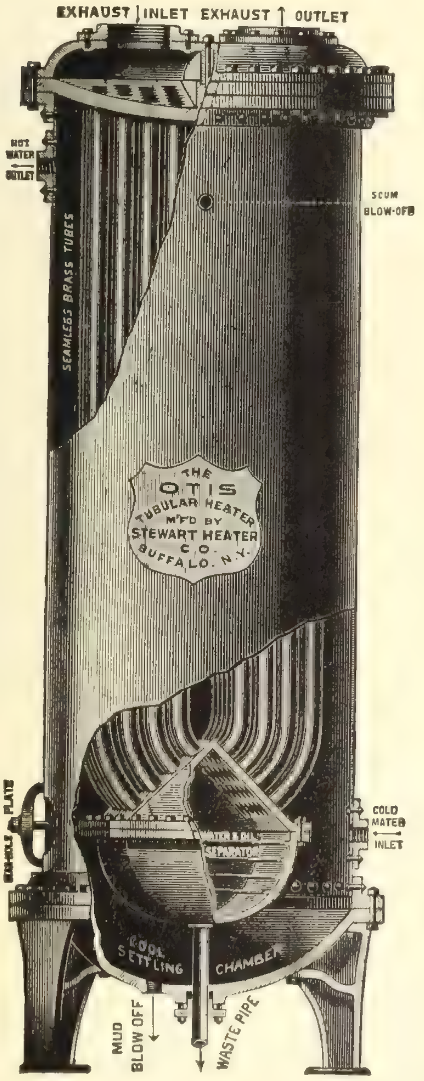

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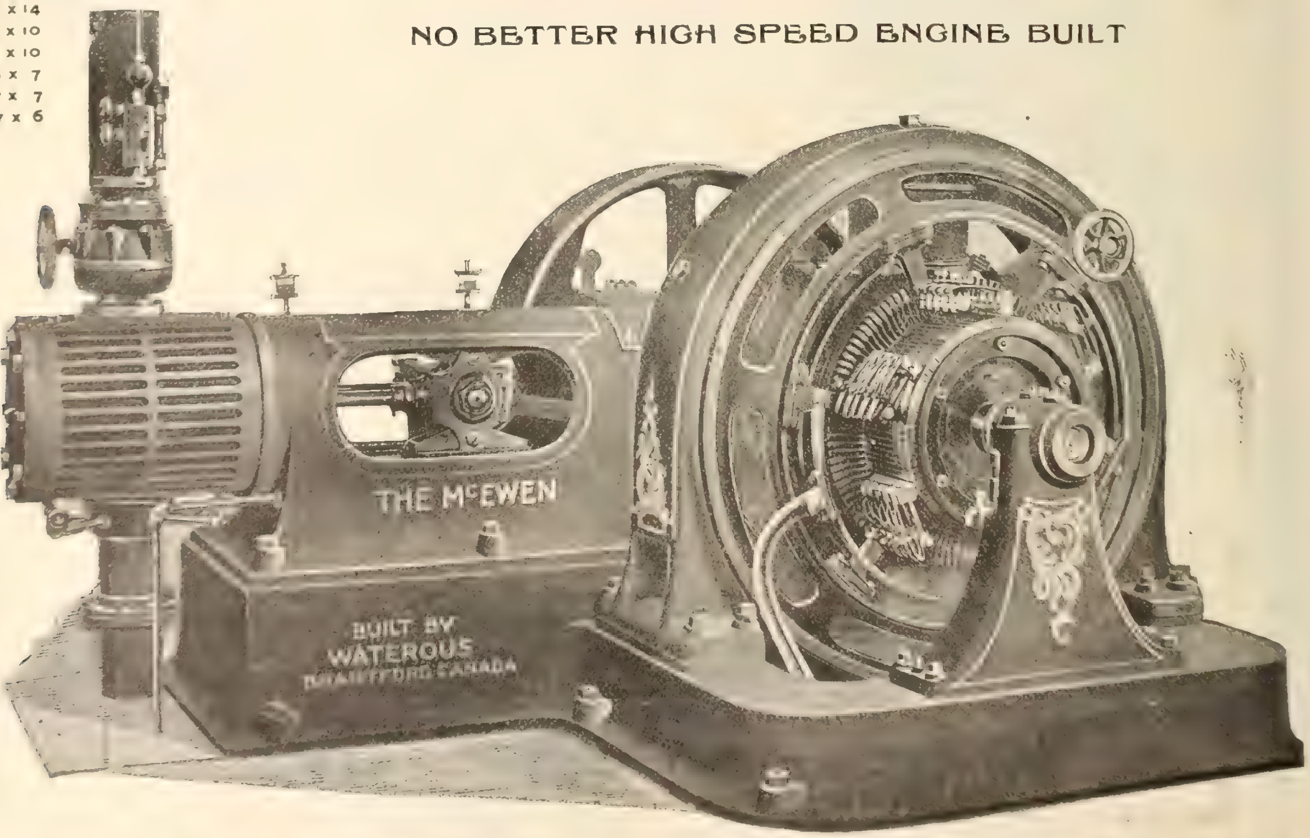

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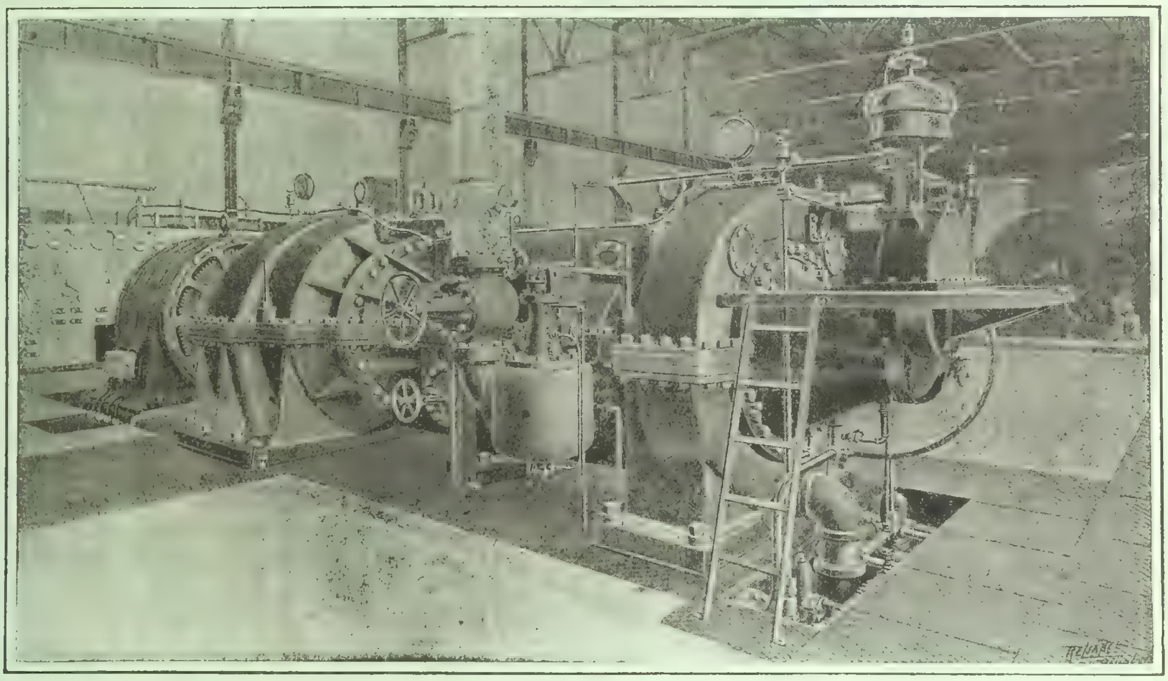

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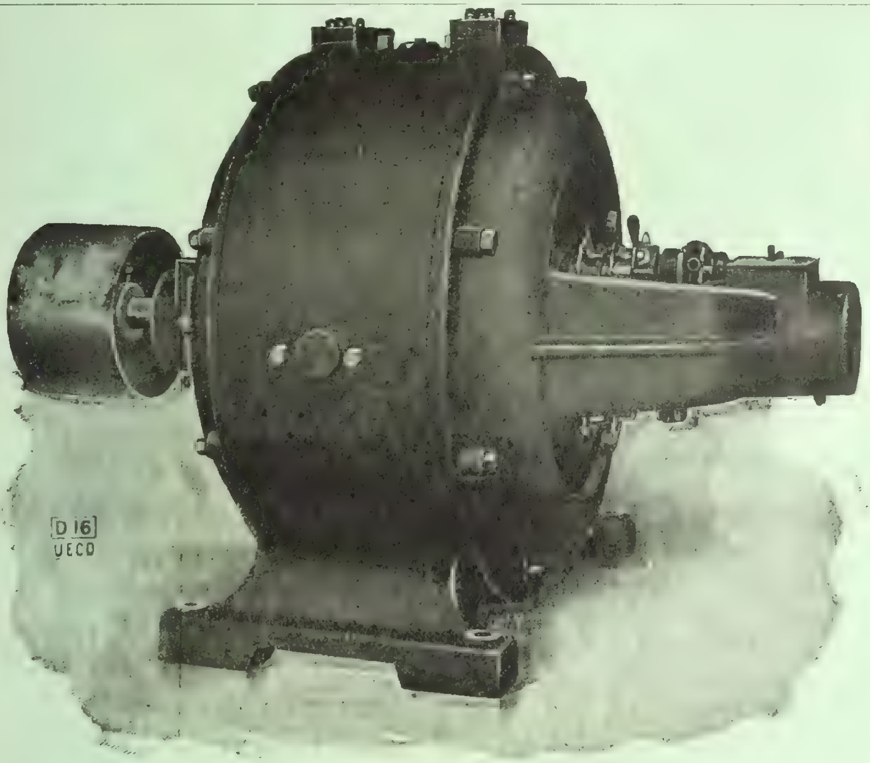

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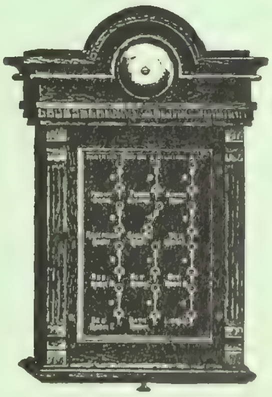

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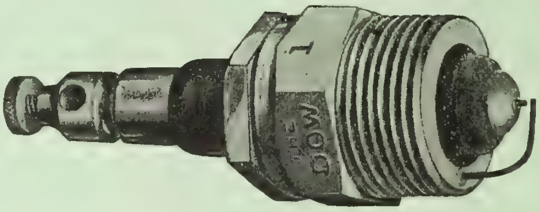

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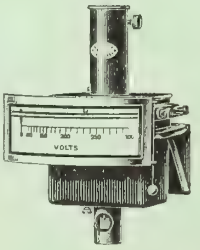

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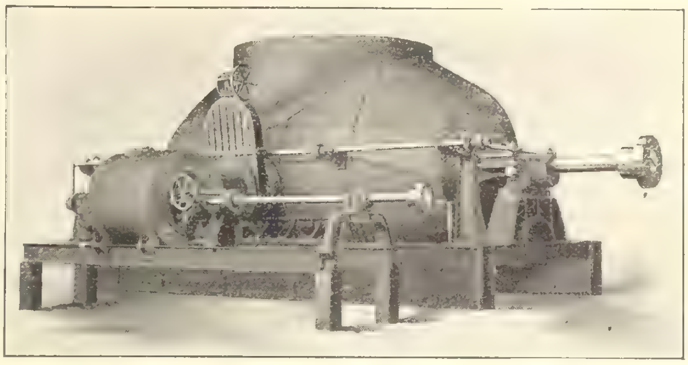

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SPARKS.

The Ottawa & Hull Power & Manufacturing Company, Hull, Que., are rearranging their distributing system and will distribute all power at 10,000 volts, three phase, 60 cycles, instead of two phase, 2,200 volts. This company sells power "wholesale" only. Eight 1,100 k.w. 10,000 volt transformers are being installed, together with the necessary switch-boards, bus-bars, etc. The plans were prepared by and work is being done under the supervision of Mr. R. S. Kelsch, consulting engineer, Montreal.

The Corporation of Edmonton, Alberta, N.W.T., through their consulting engineer, Mr. R. S. Kelsch, Montreal, have purchased and installed one 700 horse power Robb cross compound condensing engine, two 300 horse power Babcock & Wilcox boilers, one 450 k.w. Bullock Company revolving field direct connected 2,300 volt, 60 cycle generator, one 225 k.w. Bullock Company, revolving field direct connected 2,300 v. 60 cycle generator, and two 22 k.w. direct connected exciters, driven by Robb engines, also switch-boards, etc. This new plant will be started about November 15th.

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SPARKS.

The ratepayers of Glace Bay, N.S., have decided to expend the sum of $25,000 for extending the electric light plant.

The capital stock of the St. Catharines & Niagara Power & Fuel Company, Limited, has been increased from $40,000 to $100,000.

Mr. J. A. Dunn, of Halifax, N. S., has the contract for wiring the Mount St. Vincent Academy building, which will be lighted by about 1,000 incandescent lamps.

The Governor-in-Council has been asked to approve of an issue of $15,000 of debentures by the town of Niagara Falls, Ont., for the purpose of extending the electric light plant.

The application to quash a by-law of the town of Berlin, Ont., to raise $10,000 as a bonus to the Berlin, Wellesley & Lake Huron Railway, was dismissed by Mr. Justice Anglin at Osgoode Hall, Toronto.

The Hinton Electric Company, of Vancouver, B.C., are installing an electric light plant in the shingle mill of the Ladysmith Lumber Company at Ladysmith, B.C. It is expected that the latter corporation will also adopt the electric light at an early date.

Mr. John Galt, C.E., recently returned to Toronto after a visit to Regina, N.W.T., where he is installing electric light, waterworks and sewerage systems. The old electric plant will probably be retained as an auxiliary. The new plant is modern in every respect and is intended to furnish the necessary power for some years to come.

Mr. R. S. Kelsch, consulting engineer, Montreal, was selected as arbitrator to adjust the differences between the Canadian Electric Light Company and the Levis County Railway Company, consisting of the interpretation of an existing power contract, four suits and one damage claim for $10,000, and to draw new contract for power for the Railway Company. The companies signed a bond of $5,000 to abide by the decision of the arbitration. An award bas been made and the companies have complied with the same.

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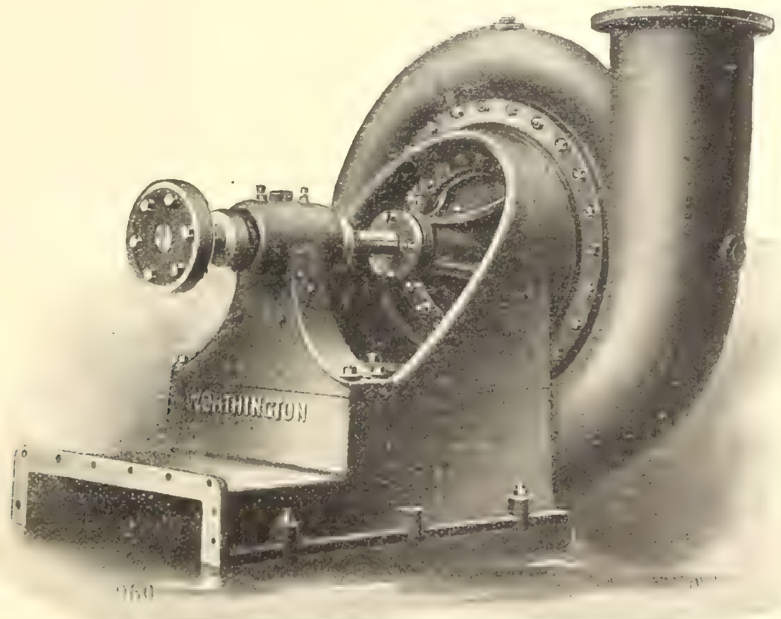

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MOONLIGHT SCHEDULE FOR DECEMBER.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Dec. 1	5 00	Dec. 2	3 10	10 10
2	5 00	3	4 20	11 20
3	5 00	4	5 30	12 30
4	5 00	5	6 30	13 30
5	5 00	6	6 30	13 30
6	5 00	7	6 30	13 30
7	5 00	8	6 30	13 30
8	5 00	9	6 30	13 30
9	5 00	10	6 30	13 30
10	5 00	11	6 30	13 30
11	5 00	12	6 30	13 30
12	5 00	13	6 30	13 30
13	5 00	14	6 30	13 30
14	10 30	15	6 45	8 15
15	11 30	16	6 45	7 15
17	0 30	17	6 45	6 15
18	1 20	18	6 45	5 25
19	2 20	19	6 45	4 25
20	3 20	20	6 45	3 25
21	4 15	21	6 45	2 30
22	No Light	22	No Light	
23	5 00	23	7 30	2 30
24	5 00	24	8 30	3 30
25	5 00	25	9 40	4 40
26	5 00	26	10 45	5 45
27	5 00	28	0 00	7 00
28	5 10	29	1 00	7 50
29	5 10	30	2 10	9 00
30	5 10	31	3 20	10 00
31	5 10	Jan. 1	4 30	11 20
		Total	....	268 15

The electric light plant at Moncton, N.B., owned by the corporation, is inadequate to meet the demands made upon it, and it is likely that next spring its capacity will be increased by the addition of a new generator, engine and boiler.

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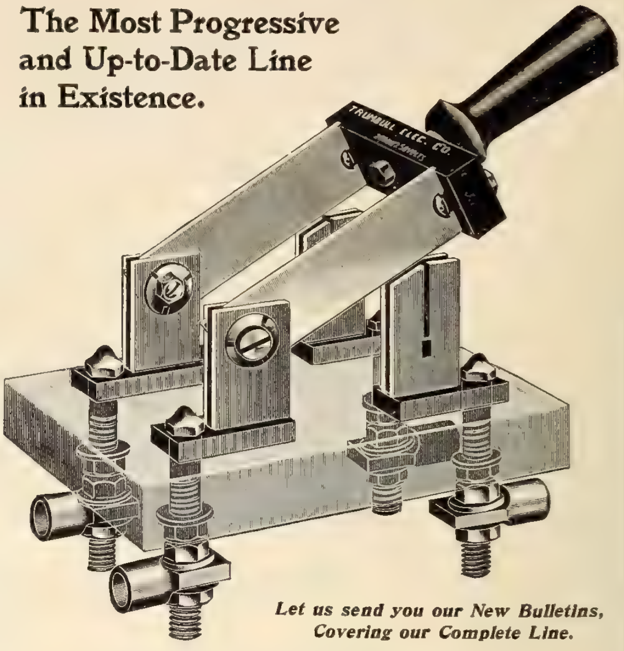

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We have regular customers in British Columbia and in Nova Scotia, which are about the limits so far as the geography book is concerned. Now these men do not like delay any more than you do, and it stands to reason that they buy their transformers in Pittsburgh not only because they like the transformers, but also because they receive them when they want them.

Pittsburgh Transformer Company,

Pittsburgh, Pa.

Pittsburgh, November, 1904.

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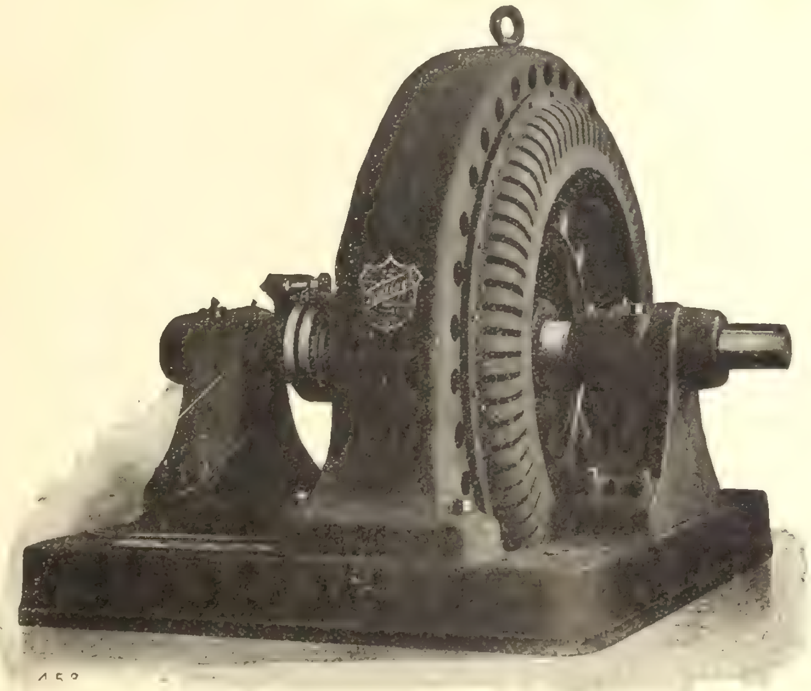

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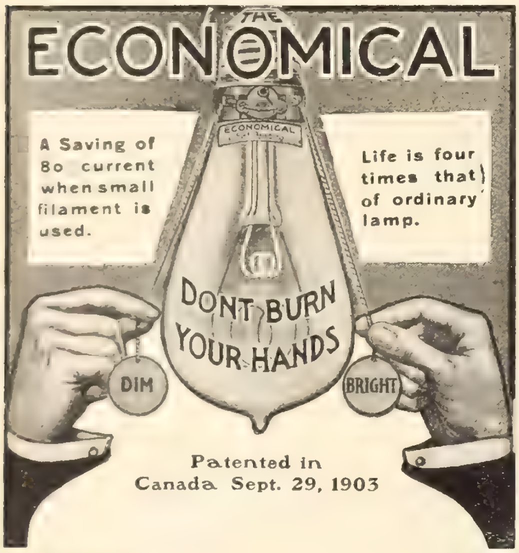
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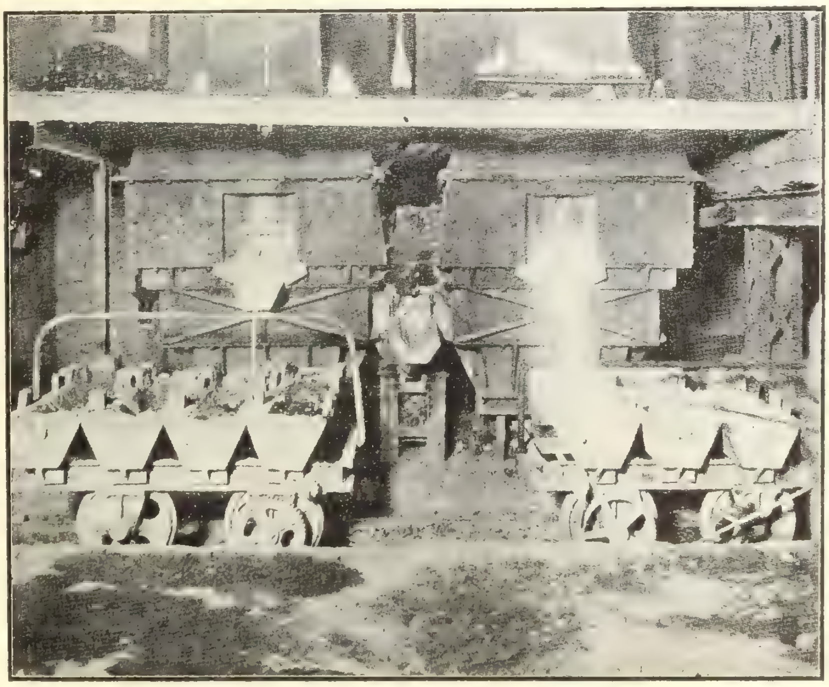
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIV. NOVEMBER, 1904 No. 11.

ELECTRIC SMELTING OF IRON AND STEEL.

The final report of the Commission appointed by the Dominion Government to investigate the different electro-thermic processes for the smelting of iron ores and the making of steel in operation in Europe, has been issued. It is a most complete report. Every statement made is based upon authoritative data, the conclusions of the Commissioners being the result of careful, exhaustive inquiries. This inquiry has excited the keenest curiosity throughout Canada, particularly as it affects the development of our many water powers and the utilization of the immense bodies of magnetic iron ore which exist throughout the Dominion.



General View of the Kellar Furnace.

The Commission consisted of Dr. Haanel, Superintendent of Mines for Canada; C. E. Brown, Peterboro, electrical engineer; E. Nystrom, M.E., Ottawa, draftsman, and Thos. Cote, Montreal, secretary. In England the services of F. W. Harbord, consulting metallurgist and analytical chemist to the Indian Government, were obtained as metallurgist of the Commission. Electric smelting plants were then visited, in the order named, at Gysinge and Korfors, Sweden; La Praz, France; Turin, Italy; and Livet, France.

At the Gysinge works steel of superior quality is made by the smelting together of charcoal-pig and scrap in electric furnaces of the induction type. The cost of producing steel by this process is estimated to be $34 per ton of 2,000 pounds, while the electric energy cost $11.50 per electric horse power year.

Steel at the works of the French Electro-Metallurgic Company at La Praz is made from scrap melted down, purified by the making of a number of slags and carbonized in the furnace by carburite. With this process the different grades of steel are made without difficulty. The absorbtion of electric energy per ton of steel amounted to 0.153 electric horse-power year (English units.) The estimated cost of producing the steel is $14 per ton of product.

THE KELLER PROCESS.

The most important experiments witnessed by the Commission were those made by Kellar, Leleux & Company at their works in Livet, France, and we will therefore describe the method at some length. The furnaces employed for these experiments were those used in their regular work of making, by the electric process, the various ferros, such as ferro-silicon, ferro-chrome, etc. The furnace is of the resistance type and consists of two iron casings of square cross section, forming two shafts communicating with each other at their lower ends by means of a lateral canal. The casings are lined with refractory material. The base of each shaft is provided with a carbon block. These blocks are in electric communication on the exterior of the furnace by means of copper bars. The carbon electrodes to which the electric current is distributed pass two-thirds of their length into the shaft. A view of the furnace is shown on this page.

The method of charging is as follows:

In starting the furnace the charge is introduced between the carbon blocks of the base and the ends of the electrodes, which latter are then in their lowest position. The current passes from one electrode through the material to be reduced to the carbon block, from thence outside of the furnace by means of the copper conductor to the other carbon block, through the charge in the second shaft, and to the other electrode. The current meeting in the two shafts, with the resistance of the charge, the latter is heated; the reduced metal flowing along the canal conducts the electric current from one electrode internally to the other electrode. The exterior current diminishes as the amount of reduced metal increases. The electrodes are now raised, the charging continues, until finally the electrodes occupy their normal positions, and the shafts below the electrodes, and between the electrodes and the sides of the shafts, are completely occupied by the charge. Under these conditions but a small current flows through the external conductor, the main current passing within the furnace from electrode to electrode. This ingenious arrangement of providing a shunt for the current enables the furnaces to be worked continuously, without at any time varying excessively the load on the alternator.

The electrodes are found by an assemblage of four electrodes of square cross-section, 11½ in. on the side, into a single mass of square cross-section, 35 in. on the side and 55 in. long.

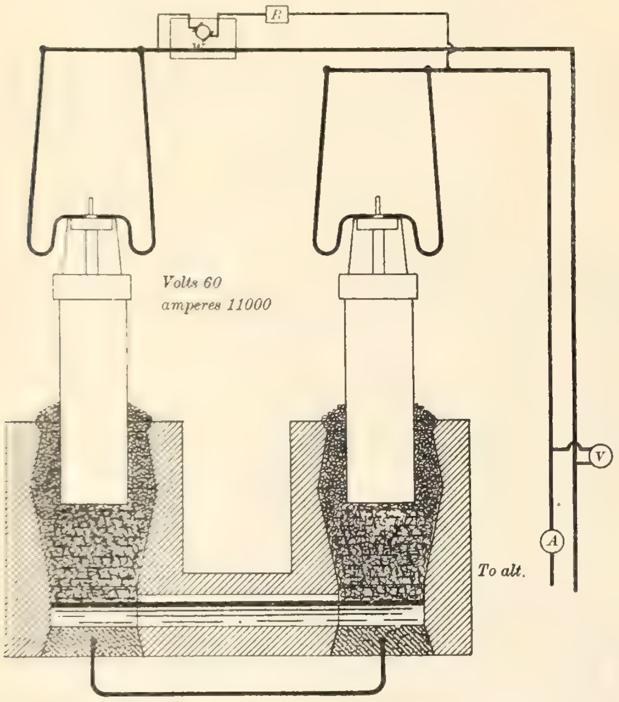


Diagram Showing the Electrical Connections of the Kellar Furnace.

The dimensions, measured after 48 hours of working, showed that the decrease of the electrodes in length was very slight. This can be understood when it is considered that the electrodes are but little affected by the passage of a current of relatively low density; the parts of the electrodes not in contact with the charge do not become heated, and the heated ends are completely submerged in a reducing medium.

Mr. Kellar contends that the electrodes employed for a furnace of ten tons output per 24 hours, and comprising two electrodes as above described, will last at least 20 days. The cost of electrodes per ton of product is estimated by Mr. Keller to be 75 cents.

Three sets of experiments were made for the Commission:

1st.—Electric reduction of iron ore and obtaining different classes of pig: grey white and mottled.

2nd.—Electric reduction of iron ore containing a definite amount of carbon in the charge, with a view of ascertaining the amount of electric energy absorbed in the production of one ton of pig iron.

3rd.—The manufacture of ordinary steel of good quality from the pig manufactured in the preceding experiments.

The different classes of pig iron, grey, white and mottled, were obtained without difficulty.

COST OF PRODUCTION OF PIG IRON.

Mr. Kellar's estimate of cost per ton of product, based on the energy consumed in the second experiment, and found to be 0.226 E.H.P. years, is as follows:—

1. Ore (Hematite, 55% iron), 1.842 tons, at $1.50 per ton	$2.76
2. Coke, 0.34 tons, at $7.00 per ton	2.38
3. Consumption of electrodes, $45.00 per ton, 34 lbs. per ton of iron	0.77
4. Lime, 300 lbs., at $2.00 per ton	0.30
5. Labor, at $1.50 per day	0.94
6. Electric energy, 0.226 H.P. years, at $10 per H.P. year	2.26
7. Miscellaneous materials	0.40
8. Repairs and maintenance	0.20
9. General expenses	0.20
10. Amortization (machinery and buildings)	0.50
Total, exclusive of Royalty	$10.71

The experiments performed at Livet show that to produce 100 tons of pig per 24 hours will require 9,750 electric horse-power at the electrodes of the furnace.

REPORT OF THE ELECTRICIAN.

The electrical details of the Keller method of producing pig-iron are given in Mr. Brown's report. Furnaces Nos. 11 and 12 were operated for the Commission on the 19th, 20th and 21st of March, and Nos. 1 and 2 on the 23rd, 24th and 25th of March. A diagram of the electrical connections of the furnace are reproduced herewith.

The electric current passes through the charge between the suspended electrode and the carbon bottom. The energy of the current is absorbed by the resistance of the charge, which is thereby heated to the temperature required for reduction. The use of the resistance of the charge as a means of heating it makes it possible to control the temperature of the reduction within narrow limits by controlling the current, and thus work at the point which experience shows to be most favorable for obtaining the most economical results.

The external copper connection is provided to maintain the circuit when the molten iron is drawn off for the interior circuit interrupted, thus making the flow of the current independent of the casting operations. The operation of the furnace is, therefore, continuous and is not interrupted by charging or casting, and it may be operated for an indefinite period without shutting down, giving very favorable conditions of load for the electric and hydraulic plants.

The furnaces are operated with alternating current generated directly on the alternator at the voltage required. The alternator is a revolving field machine, has 16 poles, and rotates at approximately 380 revolutions per minute, giving a periodicity of 50 cycles per second, and is direct connected to a horizontal shaft water wheel controlled by a governor.

The regulation of the electric input is effected chiefly by the vertical adjustment of the electrodes by hand, but this is supplemented when required by adjusting the alternator field and the water wheel governor. The load is entirely free from violent fluctuations and hand regulation requires a very small amount of attention, so that one man could readily regulate four or five furnaces. If desired, however, little difficulty should be experienced in designing an automatic regulator that would fulfill all requirements, and dispense with the services of this man.

Mr. Brown states that the electric energy was measured by a Thomson recording wattmeter, and after the run was completed it was calibrated by them under the same conditions as to volts, amperes, cycles and temperature as it had been subject to during the run in which it was used. The constant* 4390 was obtained and certified to as correct under these conditions.

The volts and amperes were read on the regular switchboard instruments, but as no calibrations for them could be obtained, their accuracy is not to be relied upon. The voltmeter was connected across the terminals of the alternator and includes the drop on the line. This drop in potential between the terminals of the alternator and the furnace was measured with 11,000 amperes on the circuit and found to be 5.5 volts.

The power factor was determined March 24th by Professor Barbillion, by means of the oscillograph. The readings of volts and amperes were taken on the switchboard instruments used during the run. The following are the results obtained :—

Mean Volts.	Mean Amperes.	Power Factor.	Mean Watts. Volts × amps. Power Factor
70.3	9890	0.743	516,583
70.1	9900	0.731	507,306
70.2	9895	0.737	511,945

The cost of electric energy per ton of pig, at $10 per horse-power per year, is shown to vary from $2.50 to $5.

It is stated that a further improvement of the power factor would be effected by using current at 25 cycles, instead of 50 cycles. There seems to be no inherent reason why a reasonably high power factor cannot be obtained by careful attention to all of the details of design affecting the electric current.

The principal electrical difficulties are in connection with the very large currents required at low voltage, and for furnaces of larger output the current will increase in almost direct proportion to the power required, the voltage increasing very little, if any. Mr. Keller has estimated that a furnace having a capacity of 20 tons per day of 24 hours would require 28,000 amperes and 70 volts. It would be extremely important, therefore, to have the lines carrying this current as short as possible to avoid excessive line loss and excessive cost of conductor. Likewise, the design of the electric machinery to furnish such large currents present especial difficulties, and its construction is expensive, whether the current is generated directly at the voltage required or reduced by step-down transformers from a convenient generator voltage. In the former case the generating station should be located immediately alongside of the furnaces ; in the latter, they may be separated as convenient, the current being transmitted to transformers located directly at the furnaces, and stepped down to the voltage required.

In the new design for furnaces of larger capacity the arrangement with four shafts will facilitate the use of quarter-phase current, which, in case transformers are used, could be generated and transmitted three-phase, if found desirable. The construction can also be modified for the use of three-phase current directly on the furnace, if required.

THE MANUFACTURE OF STEEL.

Reporting on the Keller process for the manufacture of steel, Mr. Brown says :

In starting operation, a small quantity of iron is introduced, and the current passes through it, making circuit by contacts or arcs, as the case may be, and immediately it has partially reached the liquid state, the necessary materials are added to form a slag on its surface. During this period of formation, the current is subject to violent fluctuations, but when the slag is formed, the electrodes are placed in contact with it and the energy of the current is largely absorbed by its resistance and conditions become much more stable, the furnace operating purely on the resistance principle throughout the remainder of the run.

An alternating current is used, and is supplied at the voltage required direct from the alternator, which, in this case, operated two furnaces connected in parallel. The alternator is of the horizontal shaft revolving field type, having 16 poles, and rotating at about 300 revolutions per minute, giving a periodicity of 40 cycles per second.

The regulation is effected by adjusting the electrodes vertically by hand, thus changing the resistance by varying the thickness of the layer of slag through which the current must pass.

SUMMARY OF RESULTS OBTAINED FOR PIG IRON.

IN ENGLISH UNITS.	Heroult's Process	KELLER PROCESS	
		First Run	Second Run
Total Kilowatt Hours..........	3280	33700	10840
Total Horse Power Years.......	0.50	5.15	1.66
Total Output of Pig Iron, lbs...	2130	21700	14700
Kilowatt Hours per ton of pig...	3080	3110	1475
Horse Power Years per ton of pig	0.47	0.475	0.226
Cost of electric energy per ton of pig at $10.00 per H. P. Year	$4.70	$4.75	$2.26

SUMMARY OF RESULTS OBTAINED FOR STEEL.

IN ENGLISH UNITS	KJELLIN PROCESS		HEROULT'S PROCESS			
	Charge No. 546	Charge No. 547	Charge No. 658	Charge No 660 Tool Steel	Charge No. 660 Structural	Keller Process
Total Kilowatt Hours...	[illegible]	[illegible]	[illegible]	[illegible]	1680	[illegible]
Total Horse Power Years	0.131	[illegible]	0.216	[illegible]	0.257	0.203
Output of Ingots in Lbs.	[illegible]	2100	2820	[illegible]	[illegible]	[illegible]
Kilowatt Hours per ton of Ingots.....	757	[illegible]	1000	1000	[illegible]	730
Horse Power Years per ton of Ingot.	0.116	[illegible]	[illegible]	[illegible]	0.10	0.112
Cost of electric energy per ton of Ingot at $10.00 per H P Year	[illegible]	[illegible]	[illegible]	[illegible]	$1.00	[illegible]

The conclusions arrived at by Mr. Harbord, the metallurgist, as a result of his investigation into the metallurgy of the electric production of steel and the electric reduction of iron ore, are as follows :

1. Steel equal in all respects to the best Sheffield crucible steel can be produced, either by the Kjellin, Heroult or Keller processes, at a cost considerably less than the cost of producing a high class crucible steel.

2. At present, structural steel to compete with Siemens or Bessemer steel cannot be economically produced in the electric furnaces, and such furnaces can be

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*This constant is the number by which the dial reading of the wattmeter must be multiplied to give the electric energy in watt hours. To obtain the result in kilowatt hours this constant must be divided by 1,000 and becomes 4.390.

used commercially for the production of only very high class steel for special purposes.

3. Speaking generally, the reactions in the electric smelting furnaces as regards the reduction and combination of iron with silicon, sulphur, phosphorus and manganese, are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature, by varying the electric current, any grade of iron, grey or white, can be obtained, and the change from one grade to another is effected more rapidly than in the blast furnace.

Prof. R. B. Owens,
Chairman of the Local Reception Committee which entertained the delegates to the International Electrical Congress when in Montreal.

4. Grey pig iron, suitable in all respects for Acid Steel manufacture, either by Bessemer or Siemens processes, can be produced in the electric furnace.

5. Grey pig iron, suitable for foundry purposes, can be readily produced.

6. Pig iron, low in silicon and sulphur, suitable either for the Basic Bessemer, or the Basic Siemens process, can be produced, provided that the ore mixture contains oxide of manganese, and that a basic slag is maintained by suitable additions of lime.

7. It has not been experimentally demonstrated, but from general considerations there is every reason to believe that pig iron, low in silicon and sulphur, can be produced, even in the absence of manganese oxide in the iron mixture, provided a fluid and basic slag be maintained.

8. Pig iron can be produced on a commercial scale at a price to compete with the blast furnace only when electric energy is very cheap and fuel very dear. On the basis taken in this report, with electric energy at $10 per E.H.P. year, and coke at $7 per ton, the cost of production is approximately the same as the cost of producing pig iron in a modern blast furnace.

9. Under ordinary conditions, where blast furnaces are an established industry, electric smelting cannot compete; but in special cases, where ample water power is available, and blast furnace coke is not readily obtainable, electric smelting may be commercially successful.

The International Engineering Congress will meet in Montreal next year.

Madoc, Ont., is to be lighted by electricity, the ratepayers having so declared.

AMERICAN STREET RAILWAY ASSOCIATION.

The twenty-third annual convention of the American Street Railway Association was opened at St. Louis on Wednesday, October 12, Mr. W. Caryl Ely, president, being in the chair. The attendance was about 1,100. Conventions were also held during the same week by the American Street Railway Mechanical and Electrical Association and the Street Railway Accountants' Association. President Ely, of the Street Railway Association, reviewed in his address the important work in the electric railway field during the past year, principally with respect to heavy traffic, and gave an account in detail of the New York Subway system. A considerable portion of the address was devoted to the subject of the reorganization of the Association with a view to increasing its membership. The report of the secretary showed that in September, 1904, the membership was 196. The expenses during the fiscal year were $9,559.18, and the balance on hand $7,646.56. A resolution was adopted recommending that during the coming year arrangements be made so that at the next annual convention the duties of the secretary shall be enlarged so as to require that he give his entire time to the work of the Association.

A number of valuable technical papers were presented, two of which were on steam turbines. Mr. R. H. Rice confined his remarks to the Curtis turbine, and gave a list of small sizes from 1½ to 300 k. w. which have been made, no gearing being made in the corresponding turbo-generators. In reply to a query Mr. Rice said that the commutators of the Curtis turbine run dry, lubricating carbon brushes being used, and that the commutator bars are secured by nickel-steel rings shrunk on over insulation. Mr. C. O. Mallioux said that in Europe he had seen numerous instances of direct-current dynamos driven by turbines running at from 2,500 to 4,000 r.p.m. The brushes used are generally of carbon, although in some cases metal brushes are employed, the latter requiring, however, a better electrical design. He had not heard of any cases where there had been trouble from the presence of water in the steam. He spoke of one installation where a 250 k.w. turbine was using the exhaust steam

Mr. Henry D. Bayne,
General Secretary of the Local Reception Committee which entertained the delegates to the International Electrical Congress when in Montreal.

from a 1,000 h.p. reciprocating engine, the turbine running condensing, and no trouble had been experienced.

The following officers for the ensuing year were elected: President, W. C. Ely (re-elected); first vice-president, Elwin C. Foster (re-elected); second vice-president, John I. Beggs; third vice-president, Richard McCulloch; secretary and treasurer, T. C. Pennington.

A REMARKABLE RECORD IN POWER STATION PRACTICE.

A great surprise has been given to most engineers interested in steam engineering says the Engineering Record, by the publication in the Boston Electrical Handbook of the cost of power for the 12 months ending October 1, 1902, at each of the stations of the Boston Elevated Railway Company.

The company operates about 435 miles of track by means of a power plant equipment rated at somewhat over 36,000 k.w. This equipment, in its broad engineering features, differs fundamentally from what is generally considered the best modern practice. Instead of being concentrated in a large central station it is distributed among eight, ranging in capacity from 600 to 14,400 k.w. The units are all comparatively small, the largest being rated at but 2,700 k.w. The engines are all of the reciprocating type, and most of them are of the cross-compound condensing form. Seven of the stations are located on tidewater. Three of the plants are rather old and contain small units, and the costs of producing power in them are not unusually low for similar well-managed stations.

The surprising results have been secured at the five modern stations. Their capacities and the cost of power at each are given as follows: Dorchester, 2,000 k.w., 0.7 cent per k.w.-hour; Harvard, 3,600 k.w., 0.7 cents; Charleston, 4,300 k.w., 0.755 cents; Lincoln, 8,100 k.w., 0.725 cents; Central, 14,000 k.w., 0.76 cents. These figures do not include fixed charges, but cover everything else. The average price of coal during the period was $3.60 per long ton, which should be kept in mind in comparing these figures with those of other stations, for fuelcharges make up 50 to 70 per cent. of the total operating expenses of such plants. The figures are based on carefully kept records of each item which influences the result, particularly the output, coal and water. In this way the stations are practically running under test conditions all the time and any change in cost is seen at once.

It would be strange if some of the great central stations do not furnish power at a somewhat lower cost than this, after allowing for differences in the price of fuel. It would be highly instructive to learn, however, if their better showing is sufficient to warrant their larger attendant losses in the high-tension distri-bution lines and converters. These energy losses are generally estimated at 25 per cent., and to them must be added the expense of maintenance of the high-potential system. With power furnished by small stations at such an economical figure as the Boston plants have attained, the argument for large central stations is not so one-sided as it is customarily regarded.

This aspect of the subject is not so immediately instructive as some of the others. The figures prove in many ways that skill and faithfulness on the part of station men rank along with refinements in equipment. For example, in the Central plant, with hand-fired boilers, the combined coal and labor charges are lower than in the Lincoln station with mechanical stokers, a fact which would only be possible where the boiler room is run with extreme care. It is also self-evident that the adjustment of load between so many stations is a task requiring much skill and a knowledge of the entire operating problem.

ANSWERS TO QUESTIONS.

A correspondent furnishes the following answers to the three questions asked in the October number:

1. To reverse a two-phase induction motor, put reversing switch in one phase only.

2. The sizes of German silver wire used for making electric heaters are: For 4 amps., gauge 19; 6 amps., gauge 16; 7½ amps., gauge 14; 10 amps., gauge 12.

3. In embedding wires of small electric heaters for cooking purposes, the coils are sometimes wound on earthenware, porcelain, etc., and then glazed, but the better and cheaper way is to use iron-wire coils, placing them at each side of the ouen and protecting them with enamelled iron sides. For controlling the amount of heat given out, the coils are connected in parallel and switched in or out as required.

THAWING WATER PIPES BY ELECTRIC HEAT.

In accordance with the suggestion of President Edgar at the Boston meeting of the National Electric Light Association, an investigation of methods in use for the thawing of ice in water pipes by electricity is now being made for the benefit of members. Mr. George S. Haley, of Rutland, Vt., has been appointed by President Davis as a committe to report on this subject, and Mr. Haley has the work already well under way with a view of publishing results before freezing weather sets in. Mr. Haley contributed a very full and instructive article on this subject to the "Wrinkle" Department of the Boston convention, having had considerable experience of his own in the use of electricity for this purpose, and his report, including the experience of companies under differing conditions, will be looked for with interest by members located in the zone of severe frost.

A trolley car on the Galt, Preston & Hespeler Electric Railway, coming from Hespeler, ran into the side of one of four cars of coal, which the freight motor was switching, with the result that Miss Renwick, one of the passengers, was killed, and Mr. Roake, the motorman, had one foot cut off. The accident was due to the flagman neglecting to flag the car from Hespeler.

The Electric Maintenance and Supply Company of Montreal have recently been granted a Dominion charter, and have entered the electric repair field, being equipped to handle in a thorough way all kinds of electrical repair work. Thomas Sonne, manufacturer, of Montreal, is president, and J. Barker Vosburgh, L.D.S., of Montreal, is vice-president. The electrical works are under the supervision of M. A. Sammett, B.S., an expert electrical engineer of wide experience both in manufacturing and central station work, thus placing the Maintenance Company in a position to secure best results for its customers. The company will also be prepared to do photometric test for central and isolated stations and calibrate switchboard and portable instruments. As this is the only company in Canada in this field, it should fill a long felt want in this particular line of work. We wish them every success.

THE CARE, TESTING AND ADJUSTMENT OF INTEGRATING WATTMETERS.

By K. L. Aitken.

The great number of electric light companies now in operation has made the position occupied by the integrating wattmeter a most important one. Its chief requirements are initial and continued accuracy under wide variation of load, and an almost negligible depreciation. The latter interests the power plant operator only, but the former affects alike both the operator and the consumer. In a steam driven plant, the difference between the readings of the station meters and the aggregate readings of the service meters has to be carefully watched, as this indicates the condition and efficiency of the transmission system. Also, the operator desires his meters to be accurate so that he will receive payment for the full amount of power distributed, and on the other hand, the consumer demands accuracy as an insurance against overcharging.

Speaking generally, the attention required by wattmeters is many times greater than they receive—rough handling and careless installation are usually responsible for the numerous troubles the central station manager encounters in this department. If he could see his men drop the instruments on the floor as if they were mere scrap iron, he would better understand the chief source of these troubles. On many occasions, when the accuracy of some particular meter has been questioned, the writer has found the instrument set up as much as ten degrees out of level.

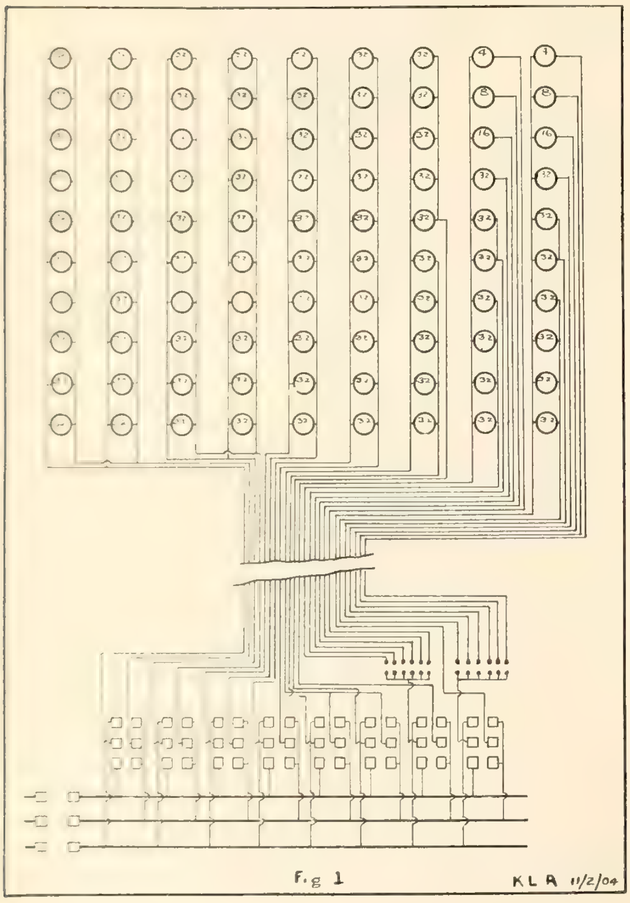

Fig 1 KLA 11/2/04

The wattmeter is, at best, but a delicate piece of apparatus, and should always be considered as such. The jewel can be lowered, and the moving element secured in various ways, but nevertheless, even when this has been done, the meter should be handled just as carefully as if the weight of the disk were resting on the jewel. This attention can never do any harm, and, no doubt, in many cases is responsible for much good.

Outside rough usage, the accuracy of a meter can be affected by a number of causes, all of which, with the exception of friction, may be charged to poor design or poor manufacture. The question of bearing friction is one requiring very careful consideration, for the lack of permanency of calibration can usually be accounted for by the varying of this factor. Friction cannot be eliminated entirely, nor can its increase in service be prevented, but if the design of the meter in the first place makes of this item an almost infinitesimal quantity, then it stands to reason that the increase due to wear will be unimportant. Allow that friction can be made an almost constant quantity, and then the proper compensation comes as a comparatively simple matter.

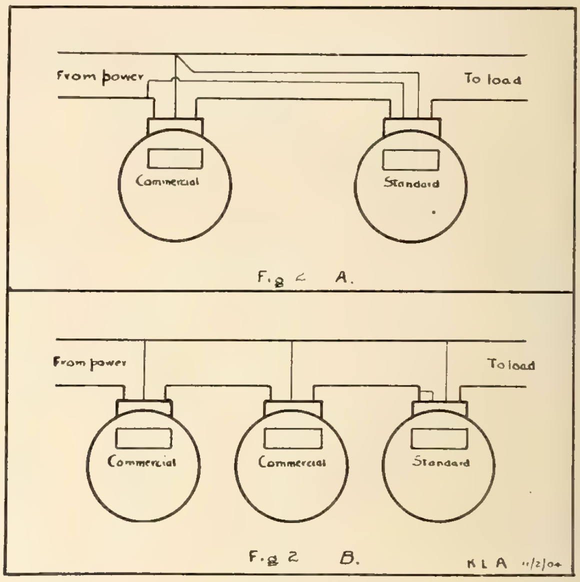

Fig 2 A.

Fig 2 B. KLA 11/2/04

When the disk of a meter is in motion, the friction is not materially affected by vibration; that is to say, the friction will remain the same whether the meter be mounted on a solid masonry pedestal, or on a thin wooden partition close to running machinery. But the static friction, or friction when the disk is not moving, will be many times greater when the meter is mounted on the solid support. Therefore, the compensating adjustment which will make a meter accurate at low load in one location, will make it creep with no load if subjected to even slight vibration. Modern meters have, however, a non-creeping device which overcomes this fault to a great extent, but adjustment has often to be made to suit the conditions under which the meter operates in service.

So far the question of accuracy has been considered from the standpoint of those locally interested only; the Government regulations in connection with this subject will now be taken up. The Electric Light Inspection Act, of 1894, states that if the consumer so desired, such electricity as used by him shall be ascertained by a suitable meter, duly tested and certified correct by an inspector, and also that no meter shall so be used which has not been tested and verified. The requirements for accuracy are such that when any meter is in operation it must not indicate more than three per cent. above or three per cent. below the reading given by the inspector's standard. If an inspector finds a faulty meter, he can do nothing but condemn same—he is not allowed to either repair or adjust the instrument. All electric light companies are required to provide, free of charge, a suitable place for the testing of all meters used on their circuits, together with such electricity, wiring, and other facilities needed for said tests. A lamp-bank is by far the most satisfactory method of providing a load. Grids can be used, but draughts of air materially affect their resistance, and the current varies accordingly. The incandescent lamp reaches its final temperature very quickly, and not being influenced by external conditions, is really the most reliable means of securing a constant current consumption. Keyless sockets should be used, and the entire bank controlled by switches within easy reach of the operator; the bank itself should be located well up the wall, or even on the ceiling, so that the light and heat will not interfere with the work of testing. In Fig. 1 is shown a lamp-bank of about eleven kilowatts capacity, the switching arrangement permitting use on either two or three wire meters, and combining latitude of control with means for fine adjustments. Many modifications of this bank can be made, but it is essential to retain the features mentioned.

In the limited space available for this article, it is not possible to show the numerous connection diagrams for meters of various manufacture. Those who are directly interested in the work, can, upon application, obtain from the makers diagrams and special instructions relating to any instrument. A large number of pamphlets have been issued on the subject, and the manufacturers stand ready to supply these upon request. The following information is of a general nature, and is given as such only.

The first consideration is to provide a non-vibrating support for the meter and test instruments, and to see, after a general inspection has been made, that such meters requiring levelling are really level. In current meters, an ammeter is the only test instrument needed, in addition to a stop-watch, but for the integrating wattmeter, an ammeter, a voltmeter, or an indicating wattmeter, or a combination of the three, is required. In using these instruments, great care must be taken in all readings ; the current and voltage must be kept constant, and in the event of a variation, same should be carefully noted, and the final readings averaged.

By far the easiest method of making tests, and the one requiring the smallest expenditure for instruments, is by use of a "standard" integrating wattmeter. With this the time element, and the great need for constant wattage, are eliminated, and therefore the chance of error is reduced. In most cases, a synchronizing of the disks is the only needed reading.

The first step after setting the meter is to give it a short run with a medium load, noting at this time that the direction of rotation is correct. Then, with all load removed, the compensating device should be moved up till the disk revolves freely, and then moved carefully back to the point where the meter just stops. This will make the torque of the compensator almost sufficient to overcome the kinetic friction.

Then, with full load, the permanent magnets should be adjusted so that the recording is at the proper rate. In some meters the poles of the permanents are entirely within the circumference of the disk, while with others the poles are only partly inside the edge. Therefore, in the former cases, a movement outward will slow the meter for a given current, and in the others, an inward movement produces the same effect. After the reading is correct for full load, other loads should be tried, making a point of a test at about one or two per cent. of the rated capacity. If a check within the Government limits is not obtained, the entire operation should be repeated, and no doubt the trouble will be found in the original adjustment of the compensator.

In checking meters, one mistake is very frequently made, and that is the attempt to run two or more instruments with the standard at the same time. This cannot be done where separate shunt leads are not provided, for while the meter nearest the load will register correctly, the one next it will show, in addition to the load, the shunt current of the first meter. In the standard, both connections of the shunt coil are brought out separate from the current leads, but in commercial instruments this is seldom the case. Fig. 2A shows the proper way to connect one meter with the standard, and Fig. 2B indicates the error just mentioned.

It is the practice of some manufacturers to send out their meters calibrated and sealed, and to assume no responsibility for accuracy if the seals be broken. This is a wise and commendable policy, for the insides of a meter are to the average electrician as the wheels of a watch are to a small boy—the taking apart is interesting without doubt, but when reassemblage is attempted, there are usually enough spare parts left over to equip a small repair department. It is therefore a safe and rational procedure to return to the manufacturer, with seals intact, any meter which is inaccurate, and this practice should apply with equal force in many cases where unsealed instruments are used.

THE MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company, submitted at the forty-fourth annual meeting of shareholders held on November 2nd last, showed net earnings of $952,826.80, as compared with $905,939.01 last year. Four quarterly dividends, amounting to $642,520, were declared, and an additional sum of $20,000 was placed to the credit of the fire insurance fund, which now amounts to $267,904.92, and $50,000 to the credit of the contingent account. The gross earnings showed an increase over the previous year of $241,037.05, or 10.84 per cent., but the operating expenses increased during the same period $194,149.26, or 14.74 per cent., due principally to the severe weather experienced during last winter and to the increase in the expenditure during the year for the maintenance of the company's property and equipment.

The operating expenses of the Montreal Park & Island Railway Company's system also showed increased operating expenses.

The number of passengers carried by the Montreal Street Railway during the year was 60,281,834, as compared with 54,592,014 in 1903 and 49,947,467 in 1902. The number of transfers given was 17,915,242. The percentage of car earnings was 62.37, as against 60.20 in 1903 and 56.39 in 1902.

The company paid the city of Montresl, in addition to the usual property and business taxes, the following amounts : Tax on earnings, $127,413.29 ; on account of snow clearing, $79,808.86, making a total sum of $207,292.15.

SOME EXPERIMENTS ON LOSS OF HEAT FROM IRON PIPES.*

By R. W. Leonard, M. C. Soc. C. E.

The difficulty of obtaining reliable data in convenient form regarding the loss of heat from warm water through the walls of metallic pipes of differing dimensions when exposed to cold air or water under differing conditions, led the writer to make a few experiments during the past winter, which was favorable for such purposes. The results of these experiments may be of interest to some members of the society.

A.

1″ standard but welded steam pipe. Black—somewhat rusty.

Inside diam.	1.048″
Outside ″	1.315
Thickness	0.134″
Length	4.25′ contains 1.581 lbs. water.
External surface	1.463 sq. ft.

B.

2″ standard but welded steam pipe. Black.

Inside diam	2.067″
Outside ″	2.375″
Thickness	0.154″
Length	3 54″ contains 5 lbs. water.
External surface	2.20 sq. ft.

C.

2″ Galvanized iron pipe. Gauge 28.

Diameter	2″
Thickness	0.016″
Length	35.3″ contains 4 lbs. water.
External surface	1.54 sq. ft.

D.

2″ Bright tin pipe. Gauge 26.

Diameter	2″
Thickness	0.018″
Length	35.3″ contains 4 lbs. water.
External surface	1.54 sq. ft.

E.

2″ Lap-welded charcoal iron boiler tube. Black.

Inside Diam	1.810″
Outside ″	2.000″
Thickness	0.095″
Length	41″ contains 3.805 lbs. water.
External surface	1.784 sq. ft.

G.

1″ standard but welded stem pipe. Galvanized.

Inside diam	1.048″
Outside ″	1.315″
Length	0.134″
Thickness	4.25 contains 1.58 lbs. water.
External surface	1.463 sq. ft.

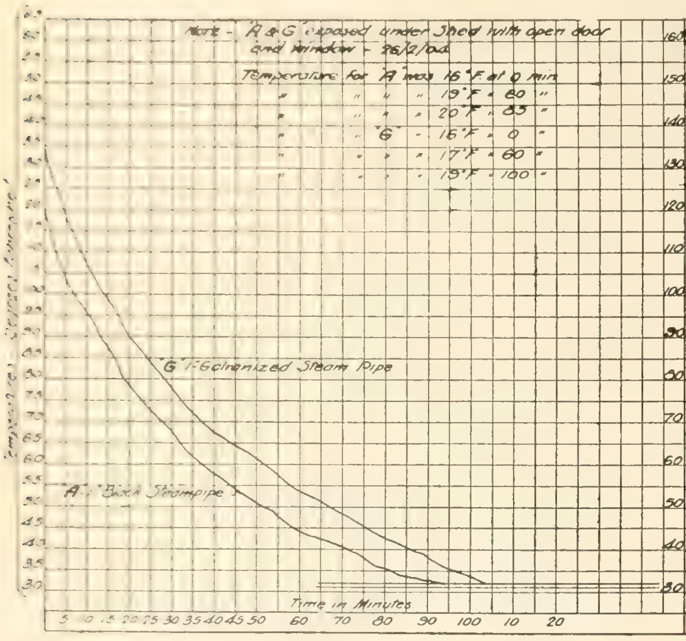

Fig. 1.

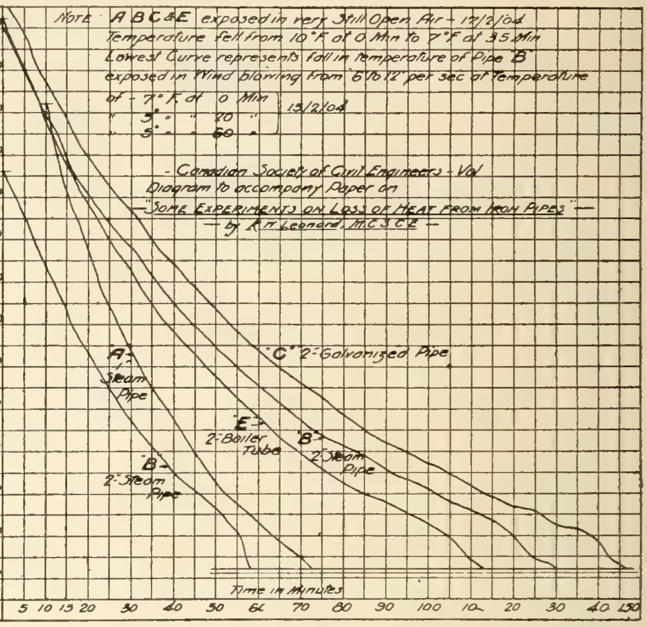

Fig. 2.

A. and G. were filled with warm water and exposed under a shed to a temperature of from 16° to 20° F., and the rate of cooling is illustrated in accompanying diagram (Fig. 1).

A., B., C. and E. were filled with arm water and exposed in the open air on a very still day (no perceptible wind blowing) to a temperature of from 7° to 10° F. The rate of cooling is illusstrated in Fig. 2, which also illustrates the rate of cooling of pipe B., exposed to a wind at low temperature.

A., B., C., D., E. were filled with warm water and submerged in still water under the ice, and the experiment was repeated in a current of water at 32° flowing at 1½ feet per sec., and the results are shown in Figs. 3 to 7. Fig. 8 shows the rate of cooling in G. in the current. In all cases the pipes were exposed in a vertical position sheltered from the sun.

All of the diagrams show irregularities which may be attributed to inaccuracies in reading the fine division on the thermometer

COMPARISON OF TRANSMISSION FROM VARIOUS TUBES.

Description.	Thickness Inches.	Ex. Surface Sq. Ft.	Contents lbs. water	Loss in B. T. U 's per sq. ft. per hour.	Temperatures Fahrenheit.
B. 2″ Welded Steam Pipe—Black	0.154	2.20	5.00	124.0	From 142 ″ 32 in still air at temp. 7° to 10° F.
B. 2″	″	″	″	112.6	″ 126 ″ 32 ″ ″ ″ 7° to 10° F.
B. 2″	″	″	″	217.3	″ 126 ″ 32 ″ wind 8″ to 12″ per sec. 5° to 7° F.
B. 2″	″	″	″	309	″ 126 ″ 32 ″ still water temp. 32°.
B. 2″	″	″	″	269	″ 116 ″ 32 ″ ″ ″ 32°.
B. 2″	″	″	″	849	″ 116 ″ 32 ″ current of 1½″ per sec. temp. 32°.
E. 2″ Lap Welded Boiler Tube -	0.095	1.784	3.805	136.7	″ 142 ″ 32 ″ still air temp. 7° to 10°.
E. 2″	″	″	″	385	″ 142 ″ 32 ″ still water temp. 32°.
E. 2″ ″ ″ ″ ″	″	″	″	1005	″ 142 ″ 32 ″ current of 1½″ per sec. tem. 32°.
A. 1″ Welded Steam Pipe—Black	0.134	1.463	1.58	115.0	″ 142 ″ 32 ″ still air temp. 8° to 10° F.
A. 1″	″	″	″	297	″ 142 ″ 32 ″ ″ water temp. 32°.
A. 1″	″	″	″	982	″ 142 ″ 32 ″ current of 1½″ per sec. temp. 32°.
G. 1″ ″ ″ ″ Galvan.	″	″	″	950	″ 142 ″ 32 ″ ″ ″ ″ 32°.
C. 2″ Gal. Iron Pipe - - - -	0.016	1.54	4.00	129.0	″ 142 ″ 32 ″ still air ″ ″ 7° to 10°.
C. 2″ - - - -	″	″	″	451	″ 142 ″ 32 ″ still water temp. 32°.
C. 2″ - - - -	″	″	″	1008	″ 142 ″ 32 ″ current of 1½″ per sec. temp. 32°.
D. 2″ Tinned Iron Pipe - - - -	0.018	″	″	470	142 ″ 32 ″ still water temp. 32°.
D. 2″ - - -	″	″	″	1224	″ 142 ″ 32 ″ current of 1½″ per sec. temp. 32°.

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*Paper read before the Canadian Society of Civil Engineers, Montreal, October, 1904.

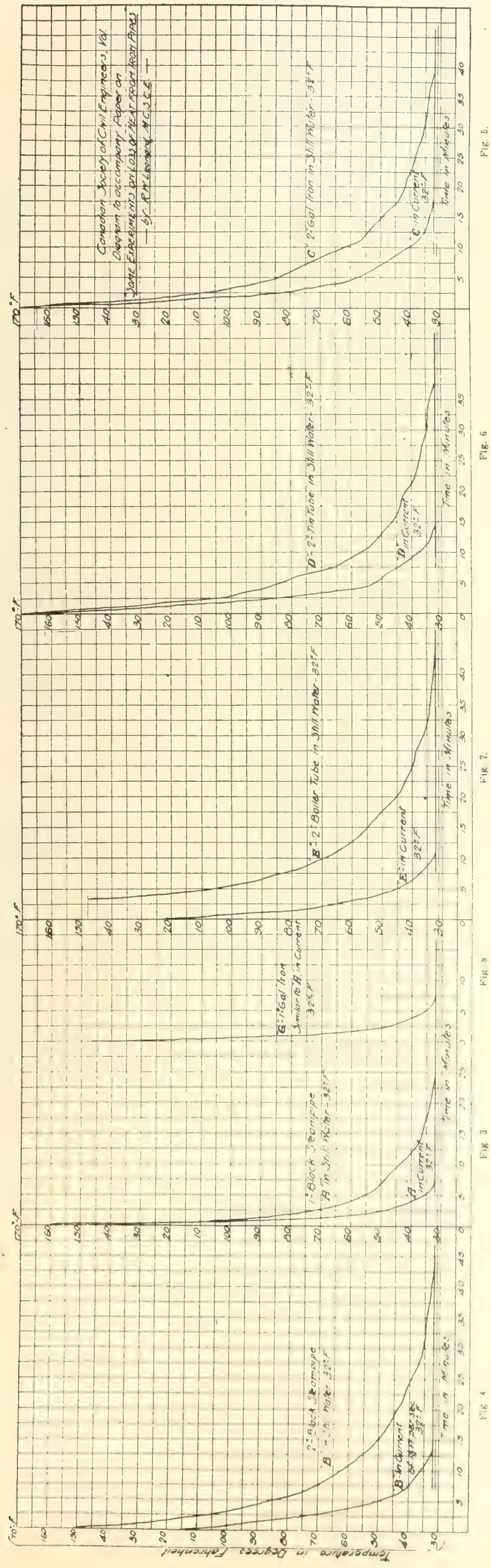

Fig. 5. Fig. 6. Fig. 7. Fig. 8. Fig. 3. Fig. 4.

and to possible irregularity in circulation of the warm water while cooling in the pipes. Apart from these irregularities the differences between Figs. 1 and 2 are interesting.

In the table on the previous page the writer compares the loss in B.T.U.'s per sq. ft. of external surface from the different pipes under the differing conditions.

From the above data it is possible to calculate approximately the amount of warm water it is necessary to pump through the hollow bars of a rack protecting water wheels in order to prevent the accumulation of frazil thereon, as it is necessary to raise the temperature of such bars but a fraction of a degree to accomplish this end.

The curves indicate that water slightly warmed loses its heat much less rapidly than hot water when exposed in a tube to a current of ice cold water.

To illustrate the practicability of this idea the example of one of the units in the extension of the Hamilton Cataract Power, Light & Traction Co.'s plant near St. Catharines may be taken.

The data are as follows :—

Head of water, 267 feet.

Capacity of turbine, 245 c. ft. per sec., delivered through steel penstock 6′ 6″ diameter.

Power of each turbine, 6,000 H. P.

Rack is 18′ 6″ wide with length of 16 ft. submerged at ordinary water level.

Thin iron pipe can be flattened to serve as bars spaced as desired and connected top and bottom with headers to form sections of the rack suitable for the circulation of warm water under pressure from a pump.

The water area through the rack may be arranged to allow of a current of 1½ feet per second, thus corresponding with the conditions existing in the experiments quoted above.

Now assume the water for warming the rack to be heated to 66° and returned to the heater at a temperature of 35° after being exposed to a current of 1½ feet per sec., in ice cold water. This loss of 31° takes place in 4 min., from a 1″ boiler tube from 1.6 lbs., of water = 50 B. T. U.'s from a surface of 1.463 sq. ft., or, say, 34 B. T. U.'s per sq. ft. in 4 min., or 510 B. T. U.'s per sq. ft. in 4 min., or 510 B. T. U.'s from 1 sq. ft. per hour.

The total pipe surface submerged in such a rack equals 695.3 sq. ft., therefore the transmissisn of heat from whole rack per hour equals 354,603 B. T. U.'s

Assume a boiler evaporating 9 lbs. water from and at 212° F. per lb. coal or yielding 8,694 B. T. U's per lb. coal (latent heat 966 B. T. U's.)

Therefore the coal required per hour to warm water equals 41 lbs., requiring a grate area of 5 sq. ft., (with 8 lbs. coal burned per hour per sq. ft. grate area) or a boiler of 15 h. p.

The quantity of water to be heated may be arrived at as follows :

1.6 lbs. water loses 31° temp. in 4 min., or at the rate of 260 B. T. U.'s per hour.

Total loss from rack (as above) 345,603 B.T.U.'s, requiring a circulation of 1223 lbs. per hour or 122 gals., or little over two gal. per min.

In order to avoid difficulties caused by the freezing of the water in the bars of the rack when the heating system is not being used it would be desirable to use some fluid which freezes only at a very low temperature.

It would appear that the same principle can be economically used to prevent the accumulation of frazil on other hydraulic machinery such as water wheel casings, etc.

It will be apparent to the reader that with a lower head of water and a corresponding increased volume, the circulation of a proportionately larger quantity of warm water would be necessary in order to effect the purpose desired, and there comes a point at which the object attained is not worth the expenditure of fuel necessary for the purpose.

D. Moore, of Qu'Appelle, N.W.T., has installed an electric light plant in his mill.

The new electric light plant at Mildmay, Ont., is now in operation and it is probable that arrangements will be made for lighting the streets.

Messrs. Wm. Snider and C. W. Schiedel, representing the Waterloo Electric Light Company, have asked for a ten years' franchise for the supply of electric light in Waterloo, Ont., but as negotiations for the purchase of the plant by the town are under way, no immediate action will be taken.

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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Development of High Tension Apparatus.

At the International Electrical Congress some very interesting facts were brought out in connection with high tension insulators. In Canada we have not as yet any very high voltage lines, and consequently the obtaining of insulators with a safety factor of three or even four, has not been found either difficult or expensive. With the introduction, however, of potentials of 50,000 or 60,000, new and more complex problems have to be dealt with, and the safety factor for such pressures, instead of being raised, has been reduced in some cases to below two. On the Toronto-Niagara line, where the potential used will be in the neighborhood of 60,000, the insulators are subjected to a test voltage of 120,000, and the behavior of these insulators, under actual service, will be watched with great interest by all high tension engineers. At St. Louis a number of instances were cited where insulators, which had been subjected to rigid water tests of 120,000 volts, had broken down in less than a month's service on a potential of 40,000, indicating that even a safety factor of three was insufficient. In the still air spaces in high tension insulators, dust seems to find a very convenient and comfortable resting place, and thus the resistance is materially decreased. On the other hand, with the type in which the petticoats are spread, the surfaces become wet, and are therefore conducting surfaces, so far as high tensions are concerned. The problem as it stands to-day is indeed a difficult one, and practically places the designer between the devil and the deep sea.

While on the subject of high potentials, we beg to call attention to the interesting information contained on page 200 of our last issue, on the 70,000 volt direct current tests. In the St. Maurice-Lausanne plant, the results will be of real value, and precedents will be established which it will be safe for the engineers of the future to follow, for the line is in commercial operation, with comparatively large capacity behind it. Experimental work, as it is usually carried on, does not enable us to draw conclusions directly applicable to commercial projects, but nevertheless is of material value, as it gives the opportunity of observing and studying the various phenomena of lower order which occur under high pressures. The building on the miniature scale of experimental apparatus for high tensions, in either direct or alternating current, brings out many of the conditions which have to be met and dealt with in actual service, but the inherent difficulty is that the really severe conditions cannot be reproduced. The 1,000 kilowatt, 1,000,000 volt transformer, exhibited at St. Louis by Purdue University, is along the same scale of experimenting as the high tension direct current line previously mentioned. A special building has been provided for this piece of apparatus, and experience has shown the wisdom of this move, as the transformer discharges to the roof and neighbouring tank bolts when the potential is raised to about 500,000. A six foot spark has been a common thing in laboratory work for many years, but never before has such a discharge been seen with so great a capacity behind it. As yet it has been impossible to raise the secondary potential to more than half its rated normal, prevailing damp weather having made proper insulation out of the question. So far all the breakdowns have been in the transformer house itself, and not out on the specially constructed line. We may be over-confident in this respect, but we would not be surprised if, when this apparatus is installed in its future home at Purdue, and is operated under full potential, that the results of the experimenting will lead to a raising of the voltage now used for commercial transmission to considerably above the apparent limit of seventy or eighty thousand.

The St. Clair Tunnel.

It seems almost incredible that a great railroad like the Grand Trunk should, for the saving of a few paltry thousands, maintain on their lines a death trap like the St. Clair tunnel. To apply such a name to this great piece of engineering appears to be carrying things too far, but nevertheless, in its present condition, nothing fits it half so well. The centre portion of the tunnel is considerably lower than either of its ends, and therefore the carbonic-acid gas discharged by the engines tends to accumulate in this lower portion, by reason of its specific gravity being greater than air. For ventilation, the movement of the entire body of air due to winds and to passing trains, is relied upon, but experience has shown that this means is, at times, entirely ineffective. We understand that several deaths have occurred in the past for which the carbonic-acid was responsible—either the men were asphyxiated in the tunnel and were found dead, or they died from the effects of the gas shortly after being rescued. With a tunnel of this profile a certain amount of poisonous air is bound to settle in the lower portion, but if this be not added to by locomotives, the means of ventilation now employed should be ample to keep the tunnel clear. Early on Sunday morning, October 9th, a freight train was being hauled to the Canadian side, when the draw-bar pulled out in the third or fourth car from the engine. The air outside was practically still, the gas in the tunnel was very bad, and as a result, before the train could be removed, four of the crew were suffocated, and of the rescue party, two were overcome. Not counting previous deaths, this gives six lives for which the present condition of the tunnel is responsible. If, instead of a freight, the accident had happened to a passenger train, the loss of life would have been terrible—and yet, all these years, the railroad has been aware of this possibility and has done nothing whatever to remedy the evil. It is simply another example of the niggardly policy of railroads that persistently risk the lives of their employes and patrons by neglect of proper safety precautions. This last occurrence cannot properly be called an accident, since the maintenance of deadly risks removes it from the category of chance happenings. It is to be sincerely hoped that this recent tragedy will bring home to the Grand Trunk officials the absolute necessity for the immediate substitution of electricity for steam, so far as this portion of their road is concerned. The solution of the problem—though it can scarce be dignified by such a term—is the electric locomotive; its use is unquestionably indicated by the existing conditions. If action be not taken by the Directors of their own accord, and at once, we trust to see the Government step in and compel them to do something. In any event, until the risk is removed, the "St. Clair Tunnel Route" will be shunned by the travelling public.

Canadian Water Power Development.

In a paper recently presented before the British Association by Mr. A. A. C. Swinton, it is stated that what was probably the first hydro-electric development with "long distance transmission" in the world, was installed by Lord Armstrong, at Cragside, Northumberland, in 1882. A 90 volt Siemens direct current generator was belt driven by means of an eight horse power turbine, operating under a head of 30 feet. The power was carried by bare overhead wires, supported by porcelain insulators on poles, to a house about a mile distant, and there used for lighting. This was just twenty-two years ago, and an interesting comparison can be made by means of the table furnished by Mr. Swinton, and printed below, showing the present hydro-electric developments of the world:

Country.	Horse Power.
United States	527,467
Canada	228,225
Italy	210,000
France	161,343
Switzerland	133,302
Germany	81,077
Sweden	71,000
Austria	16,000
Great Britain	11,906
Russia	10,000
India	7.050
Japan	3.450
South Africa	2,100
Mexico	1,470
Venezuela	1,200
Brazil	800
Total	1,466,390

It is stated in connection with the above, that great difficulty was experienced in obtaining these figures, and, that therefore, in practically every case, the amounts given are too small. We judge this to be a fact, as no mention is made of Spain, a country long famous for its water powers. It should be more than gratifying to all Canadians to note the standing of their country. The figure of 228,225 evidently does not include the recent installations at Niagara, and when the works of the three companies now building at this point are completed about 350,000 horse power can be added to the amount given. This makes Canada's claim to second place absolutely assured, and by a big margin. In concluding his paper, Mr. Swinton gives the following table of average efficiencies for a good sized hydro-electric-transmission plant:

Apparatus	Full load efficiency per cent.
Flumes, turbines, etc	75
Three phase generators	94
Step-up transformers	97
Transmission line	93
Step-down transformers	96
Low tension distributing system	95

Or a total efficiency of about 58 per cent.

While these figures will differ materially in some cases in this country and in the States, still they are sufficiently approximate for general conditions to be of value.

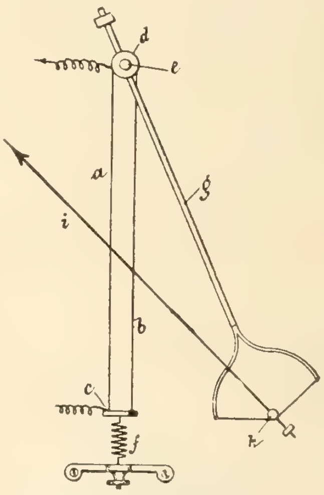
The Corporation of Napanee, Ont., have retained the services of Mr. R. S. Kelsch, consulting engineer, Montreal, in connection with the new electric light plant and waterworks to be installed by the Corporation.

INVENTION and DEVELOPMENT
IN THE ELECTRICAL FIELD

Experiments with Single-Phase Traction.—Comparative tests between the Ganz system of three-phase traction and the Finzi system of single-phase working are to be carried out shortly on the Valtellina Railway. These tests have been prompted by the successful trials of the Finzi system on the tramway system of Milan. One of the standard motor cars of the Bologna-Modena line is to be equipped for the purpose stated with four 100 h.p. single-phase motors, working at from 200 to 400 volts, and, as no starting resistances are to be used, it follows that the speed control is to be effected by transformers with variable ratios of transformation. The power is to be transmitted from the motors to the car axles by gearing, and the motor car is intended to haul a train weighing 100 tons between Lecco and Sondrio at a speed of 44.6 miles per hour. Single-phase current at 3,000 volts is to be fed into the trolley line, and will be conveyed to the motor car by means of trolleys of the same design as used at present in connection with the three-phase service.

Double-Carbon Arc Lamp.—Charles E. Harthan, of the General Electric Company, Lynn, Mass., has obtained a patent for a direct current, constant-potential double arc lamp, adapted for modern conditions. The construction of the lamp permits the two pairs of carbons to be placed near together, preferable about two inches apart, so as to prevent the arcs from being too near the inner surface of the globe. It is found that by bringing the carbons near each other the current traversing one pair has a steadying effect on the arc between the other pair ; but this effect is lost if they are so near as to exert a blow-out action. The positive line is connected with the resistance coil, from which a lead runs to one terminal of the magnet, whose other terminal is connected by lead with that one of the carbon tubes whose lower carbon is supported by a leg of the lamp. The binding post at the upper end of this leg is connected by lead with the other carbon tube, and the circuit therefrom is by way of the other leg of the lamp, a gas-cap lead and switch to the negative side of the line. In order to permit the use of inclosing globes of different lengths an improved supporting device is provided, consisting of a wire bail suspended by springs and having at its lower end a ring to receive the lower end of the globe and a depending loop serving as a finger hold in pulling down the bail to release the globe.

Hot Wire Measuring Instruments.—The Whitney Electrical Instrument Company have recently placed on the market a line of voltmeters and ammeters of the hot-wire type which embody many new features. The accompanying diagrammatic illustration shows the underlying principles : A wire a-b, of high resistance, low-temperature coefficient and non-oxidizable metal, is secured at one end to a plate c, passed around a pulley d secured to a shaft e, and its free end brought back again and mechanically though not electrically attached to the same plate c. Plate c is kept under stress by the spring f, which constantly tends to pull it in a direction at right angles with the axis of the shaft e, and is so guided that it can be moved in that one direction only. To the shaft e is likewise secured an arm g, bifurcated at one end and counterweighted at the other. Between the extremities of the bifurcated ends of the arm g is another shaft h, on which there is a small pulley and to which is attached the needle i that gives the desired indications ; a fine silk fibre is attached at one end to one of the arms of g, then passes around the pulley and the staff h, and finally has its other extremity secured to the other arm. The arms are springy and serve to keep the silk fibre taut. The current to be measured flows through the wire a only, entering and leaving as indicated by the arrows. Evidently, when a is heated by the passage of current, it expands, which, as a and b were originally under the same tension, makes a's tension relatively less than that of b, and equilibrium can be restored only when the pulley d rotates sufficiently to again equalize the strain. The rotation of d, of course, carries g with it and g, in moving, causes the silk fibre to rotate the shaft which carries the needle. If the temperature of the air surrounding the instrument changes, a and b are affected alike, and their resulting equal expansion simply results in a movement of the plate c back or forth in its path without any tendency to rotate the pulley.

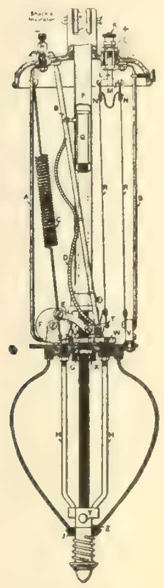


Details of New Hot-Wire Measuring Instrument.

Secret Telephone System.—Mr. Richard M. Beard, of New York, has devised a telephone system especially designed to meet the demands of persons requiring absolutely private telephonic communication and equally adapted to fill all the other requirements of telephone traffic. The disposition of the local circuits and apparatus in the central exchanges is as follows : The individual visual signal for indicating the subscriber's call is tapped directly onto one side of the subscriber's line and makes connection with the other side of the line through the jack springs when no plug is in the answering or any of the multiple jacks. The answering jack and multiple jacks are so connected together through their contacts that when a plug is in any of the jacks the line is open to every jack occurring after it in the multiple. On the keyboard the keys for each pair of cords are arranged in a separate group, consisting of one two-way listening key and two signaling keys, so that when all of the keys are in the normal position the cords are connected together, but when either of the signalling buttons is pressed the cord to which it corresponds is disconnected from the other cord and the listening key and the generator contact springs are placed in circuit with it. When the lever of the listening key is thrown the one way or the other from the normal position the cords are disconnected from each other and the operator's telephone is connected with the one cord or the other, according to the position of the lever, and all the other apparatus and circuits are arranged in the manner usually employed in central exchanges. In installations having more than one central exchange the exchanges are connected by trunk lines, as in common practice.

Arc Lamp With Hot Wire Control.—In the August number of the ELECTRICAL NEWS some particulars were given of the arc lamp with hot wire control invented by C. E. Foster, of Wimbledon, England. The following description and illustration of the lamp are taken from the London Electrician :

Referring to the accompanying illustration, the current enters the positive terminal, shown dotted, and passes down the lead S, to the post V. To this post are attached two pairs of metal strips RR, the expansion and contraction of which control the feed of the carbon. The upper end of the strips are fixed to the stirrups NN, which are hung from the rocker M, on the post L, the height of which is adjustable by the screw K, enabling the tension of the strip to be regulated. To prevent sparking at the rocker the strips are connected across just above the stirrups, as shown. The bottom ends of the strips are attached to a hook T, from which connection is made by the flexible wire D, to the upper carbon holder Q, and are free to slide in the tube P. This holder is merely a split tube, and the positive carbon is pushed home into it. The circuit from the negative or lower carbon is through the carbon holder Y, the bottom rods HH and the negative lead A, to the negative terminal. When current is turned on the strips expand; and as the bottom hook T is fixed to the end of a rigid strut B, pivoted at its upper end, the hook is pulled over to the left by the spring C, acting through the disc F and the link E. As the disc rotates it moves the lever U, shown dotted in the drawing, and thus brings into action the clutch W, which lifts the positive carbon and strikes the arc. There is a certain amount of play between the link U and the disc F, so that the wire is allowed to attain a fairly high temperature before the arc is struck. With a diminished current the heated strip shortens, and the disc is turned slightly, allowing the carbon to feed. Should the feed of the lamp prove too fast or too slow, it may be adjusted by the screw K. The lamp is fireproof, and contains no solenoid or dashpot. The upper carbon is guided by a steatite ring G, screwed into the bushing X, and the clutch is lined with the same material.



ARC LAMP WITH HOT-WIRE CONTROL.

The Davis Leather Company, of Newmarket, Ont., have decided to install their own electric plant for lighting their tannery. About 300 incandescents will be required.

PUBLICATIONS.

The Ball Engine Company, of Erie, Pa., have just published a small booklet devoted to the Robb Armstrong Sweet governor.

By permission of the Civil Engineering Department of the Masschusetts Institute of Technology, Boston, the Abner Doble Company, of San Francisco, have reprinted for distribution a thesis by H. C. Crowell and G. C. D. Lenth on "An Investigation of the Doble Needle Regulating Nozzle."

The Canadian Westinghouse Company, Hamilton, Ont., have issued a circular of unusual interest entitled "Westinghouse Generators for Three-Wire Direct Current Service. "Among the illustrations is a diagram of the connections for two three-wire generators operated in multiple. Another circular issued by this company gives a very complete description of the Westinghouse multiple alternating arc lamp.

The McGraw Publishing Company, 114 Liberty street, New York, have issued in book form a lecture delivered by Nikola Tesla before the Institute of Electrical Engineers, London, England, entitled "Experiments with Alternate Currents of High Potential and High Frequency," with an appendix by the same author on the transmission of electric energy without wires. In the latter he reviews his recent work and presents illustrations from photographs never before published. The price of the book is one dollar.

Section 1 of the Canadian General Electric Company's new Supply Catalogue, devoted to annunciators, bells, and general house supplies, is deserving of special mention, the various lines which they manufacture being very fully described. First is a complete explanation, with diagrams, of their simplified return call and fire alarm system, then ten pages are devoted to the different types of annunciators. In the push button section are shown some very artistic designs, and in the battery section are to be found illustrations of many well-known types of batteries. The Edison primary battery is described in detail and instructions given for their installation and care.

Theo. Audel & Company, 63 Fifth avenue, New York, have issued the second edition of "Self Propelled Vehicles," a practical treatise on the subject by J. E. Homans, A.M. The publishers announce that the book has been thoroughly revised and in large part rewritten. There is a vast amount of useful information to be found within its 644 pages, and it is so well arranged and illustrated that the reader cannot fail to comprehend the meaning. The general principles of automobile construction and operation are included in the opening chapters. Then follows an exhaustive account of the theory, construction and operation of gas engines occupying over one hundred pages. The succeeding chapters are of equal interest. Retail price, two dollars.

"The Power of the New York Subway" is the title of an interesting booklet published by the Allis-Chalmers Company, of Milwaukee, U. S. A., and devoted to the power equipment in the new underground Rapid Transit System of New York, which has recently been put into operation. In this power house there are installed nine Allis-Chalmers twin engines of 12,000 horse power each, being the largest aggregation of steam engines in the world. These engines are combined vertical and horizontal, compound condensing; speed, 75 revolutions per minute; stroke, 60 inches; steam pressure, 175 pounds; 500 degrees F. superheat; height of engine, 39 feet 2 inches; weight, 630 tons; high pressure cylinders, 42 inches diameter; low pressure cylinders, 86 inches diameter. Measured in electrical terms, the daily average output of the nine engines is stated to be about 800,000 kilowatt hours. This is equal to about 1,250,000 horse power exerted for one hour. The daily consumption of coal is a thousand tons, and of water 1,800,000 gallons. The consumption of lubricating oil, which is ordinarily a large item of expense in operating power plants, has in this plant been reduced to a minimum. A flood of oil is passed constantly through every bearing; it is then filtered and used over and over again. At the end of the day the actual oil consumption for the nine engines is stated to be less than one barrel.

The New Brunswick Telephone Company have extended their line from Grand Falls to Edmundston. With this extension the company has the river section of the province well covered, the line from St. John to Edmundston being about 300 miles. A second metallic copper wire has just been strung between St. John and Fredericton.

COSTS AND PROFITS OF EECTRIC RAILWAYS IN GERMANY.

The enforced publication of corporate finances and the exhaustive methods by which municipal accounts are kept and made public in Germany have enabled the Association of Electrical Engineers to collect and formulate some highly interesting statistics on the financial results which have followed the change from horse to electrical traction in street railways in that country. Within a period of four or five years the horse car practically disappeared from Germany and was replaced by electric tramway systems, which traverse all the cities and larger towns and connect each of them with practically every village and hamlet in a large and constantly extending radius. The statistics of operation of the electric roads prove that while serving the public infinitely better than any other method of city and suburban transportation yet devised, they have proved in many cases less lucrative to shareholders than the horse car lines which they replaced. There are several tangible reasons for this, some of which are more or less peculiar to Germany. Among these may be cited the fact that most German municipalities refused at the outset to permit overhead conductors to be used in important or centrally located streets, and the companies were therefore forced to use a costly type of car which would take its current in the suburban streets from an overhead wire carrying a voltage sufficient to charge at the same time storage batteries of sufficient capacity to run the car through the central districts where the trolley wire was forbidden. These storage batteries were heavy and expensive, they deteriorated steadily and were difficult to keep in order, and when the snow and ice of winter encumbered the tracks they failed so utterly in Berlin, Hanover, and other cities that thousands of cars equipped with them had to be thrown out and their storage batteries removed. It was only at this heavy cost that the overhead trolley wire secured admission to the central districts of several German cities, and there are even yet in Berlin and elsewhere long stretches on important avenues where it is tabooed and underground conductors are insisted upon as indispensable.

Moreover, there are very few municipalities in Germany where electric power can be generated by any other or cheaper power than that of steam or gas engines, and no form of steam fuel is really cheap in that country. Although a very few of the largest central stations produce electric power as low as 1¼ cents per kilowatt hour, in most others the cost averages from 2¼ to 3¾ cents, and in certain small stations as high as 10 cents per kilowatt hour. Estimated by the ordinary German standard, the power consumption per car varies with grade, curves, and other conditions from 450 to 700 watt hours per car kilometer, equal (in case of the latter figure) to 1,170 watt hours per car mile.

The rates of fares in most, if not all, German cities are rigidly restricted by the authority granting the concession. In Berlin, for instance, street railway fares anywhere within city limits are restricted to 10 pfennige (2.38 cents), and for the same sum the passenger may ride on some of the suburban lines any distance up to 7 kilometers (4.34 miles). From the latest published statistics it appears that the average street railway fares paid in 11 principal German cities during the year 1903 varied from 2.2 cents each at Frankfort to 2.72 cents at Hamburg, the mean average for Berlin and its suburbs being 2.35 cents, or less than half the usual 5 cent fare that prevails generally in this country. To complete the restrictions under which street railways operate in Germany, most of their charters contain clauses providing that from a prescribed date the company shall pay to the municipality a portion of its surplus after disbursing a stipulated percentage as dividends. A typical contract of this kind stipulates that beginning with 1903 the company shall pay to the city 35 per cent. of its surplus remaining after a 6½ per cent. dividend has been paid to stockholders, and 50 per cent. of the surplus after an 8 per cent. dividend. Many charters further provide that after being operated by the companies for a specified term of years the whole installation, tracks, power plant and equipment, shall revert in fee simple to the municipality which has granted to the corporation for a term of years the use of its streets.

The total length of German street railways at the close of 1902 was 1,906 miles, of which 346 miles, or about 18 per cent., were under municipal ownership. Of the latter 65 miles were leased to individuals, leaving 281 miles of lines operated directly by the municipalities. The four longest municipal lines are at Frankfort, 26½ miles; Dusseldorf, 25 miles; Munich, 29 miles, and Cologne, 40 miles. It does not appear that fares over these lines are lower, but, on the contrary, that they are rather higher than those charged on similar lines worked by individuals or corporations. In Nuremburg, for example, the principal street railway charged, under private management, a uniform 10 pfenning (2.38 cents) rate, until the city, in order to complete a zone system, took over the private line and thereupon increased the rate of fare. On the whole, it cannot be said that experience has increased public sentiment in Germany in favor of municipal management of street railways, and several cities—among which is Barmen—which built their own lines are now considering the plan of leasing them to private companies.

By far the largest and most important corporation of this kind is the Great Berlin Street Railway Company, which, with its various branches, operates 200 miles of track, of which 144 miles are owned and the remainder are controlled by the company. On its own lines the "Grosse Berliner" ran last year 40,400,000 car miles and carried 295,000,000 passengers, whose fares aggregated $7,025,000. The total capital of the company is 100,082,400 marks (23,819,611); its shares are to-day worth 184, and its 3½ per cent. bonds are quoted at 99.40. This, however, is the status of an exceptionally powerful and ably managed company in a large, level city, and is quite above the average financial condition of street railway companies elsewhere in Germany, most of which have to be satisfied with 4 and 5 per cent. net earnings on their stock.

The Berlin company is at present in litigation with the city over a question which, as it involves the important point whether a municipality may grant franchises to new companies on streets already occupied by another lessee, has a certain pertinent interest in this connection. About two years ago there was opened for traffic the so-called Elevated and Underground Railway, a double-track electric line of most perfect construction and appointment, with two arms or branches running from a central station to points in the eastern and western parts of the city. Trains of three cars run over these branches at intervals of three to five minutes, and at such speed as to traverse a distance of 2½ miles in about ten minutes. The line is very popular and carries an immense and steadily growing traffic, which naturally trenches more or less upon the business of the surface lines which belong to the "Grosse Berliner." In order to reach a still more central and crowded portion of the city the new company asks authority to extend its subterranean main stem from the present terminus at the Potsdamer Railway station northeastward to a point beyond the river To this the Great Berlin Company objects, and the municipality has applied to the courts to confirm its authority to disregard the protest and grant the franchise for what would be an important public improvement.

MECHANICAL EQUIPMENT OF HEAT MEASURED BY ELECTRICAL MEANS.

Prof. Howard T. Barnes, of McGill University, Montreal, presented at the International Electrical Congress at St. Louis, in September last, a valuable but highly scientific paper on the above subject. Summarizing the facts contained in the poper it is found :

(1) That the mechanical measurements of the equivalent differ by 1 part in 1000, the result by the continuous method being below that by Joule's method.

(2) That by accepting the latest values of the Clark cell and the ohm, the result by the continuous electrical method is brought into absolute agreement with the mean of the mechanical measurements.

(3) That the measurements by the electrical method of Joule give results that are too high, but the deviation from the continuous electrical method is in the same direction as that shown by a comparison of the same methods applied directly.

(4) That it seems advisable to select a thermal unit which is a mean over the range between 0 degs. and 100 degs., and thus independent of any temperature scale.

(5) That the most probable value of the mechanical equivalent measured by electrical means is 4.186 joules in terms of the mean unit.

(6) That the value of the equivalent in terms of a unit at any intermediate temperature may be obtained by reference to the variation curve for the specific heat of water obtained by the continuous electrical method, and which when integrated gives a value of the mean equivalent equal to 4.186 joules.

Whatever changes may be made in the values of the electrical units, which are used for calculation in this paper, our conclusions in regard to the mean of the direct-mechanical measurements will remain unaffected. Thus the mechanical equivalent which we have recommended above need not be changed, for by the agreement of the electrical methods with the mechanical it is probable that we have values of the electrical units very near the truth.

Messrs. Collyer & Brock, electrical contractors, Montreal, advise us that the only change in their firm is the retirement of Mr. Clayton, who has been a partner for the past eighteen months. Messrs. Alfred Collyer and G. N. Brock will continue the business as heretofore under the same name.

THE LEVIS COUNTY RAILWAY.

The gross earnings of the Levis County Railway Company, which operate an electric railway in Levis, Que., was $35,044.04 for the fiscal year ending June 30, 1904. The operating expenses for same period were $23,201, leaving a net income of $11,843.04. Deducting interest and fixed charges of $10,831.13, the surplus from operation is shown to have been $1,011.91. The inability of the company to obtain power caused the operation of the road to be discontinued from the 2nd of July to the 9th of August, which resulted in a loss in income of upwards of $7,000. A settlement was recently affected with the Canadian Light & Power Company and the cases taken from the Court. A new five-year contract for 600 horse power at $18.33 per horse power was signed on the 8th of October, which is $1.66 per horse power less than the old contract.

A steam power station of 700 horse power capacity was projected last July in two units of 350 h.p. each. One set has been purchased, and will be put in running order, and will be a very valuable asset to the company as a reserve to their present source of power.

The extension of their line to the Chaudiere Basin, about two miles up the river from the present terminus, will likely be undertaken as soon as the balance of the company's securities are placed.

TORONTO BRANCH A. I. E. E. MEETING.

The tenth regular meeting, and the first monthly meeting for the season of the Toronto branch of the American Institute of Electrical Engineers was held on Friday, October 28th, in their spacious assembly room at the Engineers' Club, 94-96 King street west.

The feature of the evening was a paper introduced for discussion by Mr. R. G. Black, entitled, "Ground Shields for Transformers", by Mr. F. J. Peck. The discussion which followed brought out the fact that the underwriters in framing their regulations had given attention only to questions affecting the fire hazard and had neglected to provide the necessary precautions against accidents and loss of life.

The organization of local branches has been actively promulgated by the American Institute of Electrical Engineers during the past two years. The Toronto branch was organized May 28th, 1903, and has since been steadily growing in strength and influence.

The object with which local branches have been encouraged is to enable the members of the Institute unable to attend the New York meetings to come together and hold local meetings of identically the same character as the New York meetings. These meetings are usually held two weeks after the New York meetings and the papers presented at the New York meetings are available for presentation and discussion.

The value of the Toronto branch to local members of the Institute cannot be overestimated. The opportunity to co-operate with other Institute members in the discussions should appeal to engineers or persons interested in electrical work. The Toronto branch is doing good work ; the membership is growing rapidly and the season's work promises to be of great interest and value.

The Canadian Oil Company, of Toronto, are establishing a warehouse at Nelson, B. C., which will be the distributing point for the Kootenay district.

TELEGRAPH and TELEPHONE

OTTAWA BRANCH G.N.W. TELEGRAPH COMPANY.

During the past month it was announced that Mr. Norman W. Bethune, who for the past forty years has been manager of the Ottawa division of the Great North-Western Telegraph Company, had retired from the service and had been succeeded by Mr. F. R. Carney, of Chicago.

Mr. Bethune is one of the oldest telegraph operators in the Dominion. He was born in Montreal in 1828 and entered the service of the Montreal Telegraph Company in 1847 at nineteen years of age. He was one of the first class of young men taught to operate in order to fill the offices of the Montreal Company, whose lines were then in process of construction, and is the only survivor of that class. He opened the first office on that company's line east of Toronto in July, 1847, and served in several other offices, and in 1849 was placed in charge of the Canadian end of the Montreal and New York line. In 1850 he was removed to Troy, N.Y., where he remained for five years, returning to Montreal in 1855 as local manager of that office. In 1863 he was removed to Ottawa, where for forty-one years he has filled the position of manager for the Montreal Telegraph Company and the G.N.W. Telegraph Company, which leased the wires of the former company. Under his management the Ottawa Valley has become covered with a network of telegraph wires, and the growth of the business has been due in no small part to Mr. Bethune's special tact and judgment.

Mr. N. W. Bethune,
Retiring Manager G.N.W. Telegraph Company, Ottawa.

The G.N.W. Telegraph Company, in whose service he has been for the last twenty-two years, have granted him a liberal retiring allowance for life, which is a fitting recognition of his record of fifty-seven years of continuous service in the telegraph field.

On his recent retirement Mr. Bethune was presented with a complimentary address and a valuable cabinet of sterling silver in token of the esteem in which he is held by his friends and fellow citizens of Ottawa, the presentation being made by Sir Sanford Fleming on behalf of the subscribers.

Mr. F. R. Carney, who succeeds Mr. Bethune, was born in Dubuque, Ohio, March 27, 1872, and since boyhood has been connected with the telegraph business. He served with the Western Union Telegraph Company as manager at several points and with the Postal Telegraph Company as the Chief of the Delivery and Service Departments at Chicago, where he had 432 messengers under his charge. The latter position is one that few telegraph men are familiar with on a large scale, and it afforded an opportunity for very valuable experience.

Mr. Carney is a practical electrician and familiar with all departments, and, with the benefit of his experience, he will no doubt upbuild the business in Ottawa and render a first-class telegraph and messenger service. He has a genial and pleasant manner which will soon win him many Canadian friends. He is married and has three children.

Mr. F. R. Carney,
New Manager G.N.W. Telegraph Company, Ottawa.

THE AUTOMATIC VERSUS THE MANUAL TELEPHONE EXCHANGE.

In a paper on the above subject read by Mr. Kempster B. Miller before the International Electrical Congress, the author asks the question : "It is possible to make a machine serve to effect the electrical connection of any line, in a large or small group, with any other line in the group, for the purpose of telephone communication, and afterwards to effect a disconnection when required?" There can be, he says, even at the present early stage of development, but one answer to this question. That it is. The automatic switchboard at Grand Rapids, Mich., recently selected 100 differect lines chosen at random from among approximately 5,000 lines centering in that office. Some of the subscribers called did not respond, which will occur in any system; and some of the lines were automatically reported busy, which is to be expected; but in no single case was the wrong line chosen, and in but one case was the disconnection improperly secured. The verdict of a large number of the subscribers interviewed by Mr. Miller in that city was practically unanimous to the effect that they uniformly secure their connections and disconnections promptly, accurately and satisfactory.

On the question of cost Mr. Miller says :

"Taking the system as a whole, we find that the present automatic system is considerably higher in first cost than the manual system, and assuming that interest and depriciation are at the same rate in each case, this shows to considerable disadvantage against the automatic system in the annual charges due to these items alone.

"For an exchange of 5,000 lines served by one office, the cost of automatic equipment, including telephones, may be taken at $35 for each individual line. In manually operated exchanges the corresponding cost is not far from $25 per line. The difference becomes greater—that is, more in favor of manual—for smaller offices, and smaller or less favorable to the manual in larger offices.

"Whether or not the depreciation on automatic apparatus should be taken at a higher rate than that on the manual is a question that we have not at present sufficient data or information to determine. It is true that in the present manual switchboard the flexible cord nuisance found in all present forms of manual switchboard apparatus is largely eliminated. It is also true that the automatic apparatus is more complicated, and requires greater care in its maintenance; but whether, if both systems are maintained with reasonable care, the automatic will show a much greater rate of depreciation than the manual, I am not at all certain. Much of the depreciation in manual telephone apparatus is due, not to the fact that the apparatus wears out, but rather to the fact that the apparatus is rendered obsolete by new inventions. That the same will be true in the case of automatic apparatus cannot be doubted, but it is a good point to bear in mind that if telephonic development should point toward automatic apparatus, to the exclusion of manual, and should prove the superiority of automatic, then the highest developed and newest manual apparatus will depreciate greatly in value by that fact alone. It does not seem unreasonable, therefore, to place the rate of depreciation on both manual and automatic apparatus at about the same figure.

"In point of maintenance, the advantage must be conceded to the manual. This is certainly true at present, with regard to both the central office and the subscribers' station apparatus. No good reason is apparent why it should not always be true. Automatic apparatus is especially at a disadvantage at the subscribers' stations, and it is really at this point that the automatic system seems to involve a poor engineering feature. The tendency of telephone development in regard to sub-station apparatus has been until lately along what seemed to be unquestionably good engineering lines. The sub-station apparatus has been gradually simplified, the battery has been removed, as has also the magneto generator, and the instrument has been reduced to the simplest fundamental parts.

The Ontario Independent Telephone Company have been granted a franchise by the town council of Amherstburg, Ont.

In 1901 the Bell Telephone Company's building in Winnipeg was enlarged to carry 2,500 lines and the central energy system installed. It was thought that this enlargement would be sufficient for some years, but already it has been found necessary to further increase the capacity of the exchange. A large addition is now being built which will greatly increase the accommodation, and to help out in the present rush they are installing another 1,500 lines on the present board. The new board which will be installed when the new building is completed will have a capacity of 10,000 lines.

PRIZES TO WESTINGHOUSE COMPANIES.

The prizes awarded to the Westinghouse Companies at the Louisiana Purchase Exposition are announced, as follows:

Special award in the Department of Machinery for "the best, most complete and most attractive installation".

TWELVE GRAND PRIZES.—To the Westinghouse Electric and Manufacturing Company, for "Alternating current generators and motors, alternating current turbo-generator installation, static transformers, and rotary converters". To the Westinghouse Electric and Manufacturing Company, for "Direct current generators and motors". To the Westinghouse Electric and Manufacturing Company, for "Electric railway motors, alternating current and direct current, and control systems for single and multiple unit operation and for mining and industrial locomotives". To the Westinghouse Machine Company, for "Horizontal gas engines and steam turbines". To the Westinghouse Air Brake Company, for "Air brakes and friction draft gears". To the Westinghouse Traction Brake Company, for "Brakes for electric cars". To the American Brake Company, for "Driver brakes". To the Westinghouse Automatic Air and Steam Coupler Company, for "Air and steam couplers". To the Westinghouse Brake Company, Limited, London, England, for "Air brakes and accessories". To the Westinghouse Company, Limited, of St. Petersburg, Russia, for "Air brakes and accessories". To the Union Switch & Signal Company, for "Signal system". To the Cooper Hewitt Electric Company, for "The development of the mercury vapor arc lamp.

EIGHT GOLD MEDALS.—To the Westinghouse Electric and Manufacturing Company, for "Complete switchboards and controlling apparatus, and the application of electric motors for mechanical purposes." To the Westinghouse Electric and Manufacturing Company, for "Alternating current, direct current, and Bremer arc lamps and arc lighting systems." To the Westinghouse Electric and Manufacturing Company, for "Electric measuring instruments." To the Nernst Lamp Company, for Nernst lamps." To the Cooper Hewitt Electric Company, for "Vapor lamps for photo-engraving." To the Pittsburg Meter Company, for "Water and gas meters." To the Westinghouse Electric and Manufacturing Company, for "Industrial betterment work." To the Westinghouse Air Brake Company, for "The housing of the working classes."

FOUR SILVER MEDALS.—To the Westingouse Electric & Manufacturing Company, for "switches, fuses and wiring appliances." To the Sawyer-Man Electric Company, for "incandescent lamps." To the Bryant Electric Company, for "electric light fittings." To the Societe Anonyme Westinghouse, Havre, France, for "gasoline automobiles."

ONE BRONZE MEDAL.—To the Perkins Electric Switch Manufacturing Company, for "electric switches."

SPARKS.

The City Council of Fredericton, N.B., have appointed a committee to report as to the cost of installing an electric plant to light the municipal buildings.

The Brantford Electric & Operating Company, Brantford, Ont., are seeking a ten-year renewal of their lighting contract with the city. They agree to install the alternating enclosed arc system.

Mr. T. W. Goulding, formely manager of the Western Union Telegraph Company's offices at Vancouver, B. C., and later superintendent of the Pacific Division, with headquarters at Seattle, has received the appointment of general superintendent of the European agencies of that company. He will be located in London, England. Mr. Goulding has been associated with telegraphy for the last twenty-five years, having commenced as messenger for the G. N. W. Telegraph Company in Winnipeg in 1876.

The Hamilton Board of Trade, at a special meeting held October 12th, 1904, passed a resolution in favor of the early completion of the Trent Valley canal, and urging upon the Minister of Railways and Canals the importance of a full and comprehensive report on both routes based upon modern methods of canal construction, such report to include an estimate of the cost of improving and deepening the harbors of Port Hope and Trenton, the cost of operating railway and road bridges, and the expenditure incurred in buoying and lighting both of the proposed routes from the mouth of the Otonabee river. The adoption of the resolution followed the delivery of an illustrated address by Mr. J. Alex. Culverwell, of Port Hope, managing-director of the Central Ontario Power Company.

ELECTRIC LIGHT AND POWER IN MONTREAL.

The Montreal Light, Heat & Power Company, of Montreal, controls the following companies: The Montreal Gas Company; The Royal Electric Company; The Montreal & St. Lawrence Light & Power Company; The Imperial Electric Light Company; The Lachine Rapids Hydraulic & Land Company; The Standard Light & Power Company; The Citizens Light & Power Company; and The Temple Electric Company.

These companies at the time of consolidation were operating a great variety of systems, among which were the following:—

5,000 v. 3 phase, 60 cycles transmission.
25,000 v. 3 phase, 66 cycles transmission.
2,300 v. 3 phase, 60 cycles underground and overhead distribution.
2,200 v. 2 phase, 66 cycles underground and overhead distribution.
115 v. lighting service, 3 phase, 60 cycles.
52 and 104 v. lighting service, 2 phase, 66 cycles.
550 v. motor service, 3 phase, 60 cycles.
550 v. motor service, 2 phase, 66 cycles.
250 v. motor service, direct current.
250-500 v. 3 wire motor service, direct current.
Wood arc machines, 125 light, 9.6 amp., open arc circuits.
Brush arc machines, 125 light, 9.6 amp., open arc circuits.
T. H. arc machines, 50 light, 9.6 amp., open arc circuits.
W. E. Co. Reg., 50 light, 7 amp., enclosed arc circuit.

All of the above properties are being consolidated into one large uniform system. It is expected that the change will require at least two years' time. Considerable progress has been made in the work, which when completed will make the Montreal Light, Heat & Power Company's system one of the finest electric properties on this continent. Mr. R. S. Kelsch, consulting engineer, Montreal, is preparing the plans and supervising the work. Mr. Kelsch was the general superintendent and engineer of the Lachine Rapids Hydraulic & Land Company until that company was absorbed by the Montreal Light, Heat & Power Company—the latter company immediately retaining his services for the above work. Mr. Kelsch's central station experience covers a period of over twenty-two years.

The Montreal Light, Heat & Power Company also have exclusive control of the power delivered on the Island of Montreal by the Shawinigan Water & Power Company, from Shawinigan Falls, Que., 85 miles north-east of Montreal. The power is transmitted at 50,000 volts and will be merged into the general system of the Montreal Light, Heat & Power Company. The latter company now controls a total capacity in steam and water power of 100,000 horse power.

The Board of Water, Light and Power Commissioners for Fenelon Falls, Ont., has closed a contract with the Ambursen Hydraulic Construction Company, of Boston, for the construction of a concrete-steel power dam in the Fenelon river for municipal lighting. The dam is 200 feet long and is about 10 feet high. The work was commenced on the 6th instant and will be finished about the 1st of November. Mr. E. Bradley, C. E., of Montreal, is the Canadian representative of the Ambursen Hydraulic Construction Company.

PERSONAL.

Mr. James Bannan, chief engineer at the City Hall, Toronto, has been elected fourth vice-president of the International Union of Steam Engineers.

Mr. Charles H. Mitchell, C.E., of Niagara Falls, Ont., was recently unanimously elected to the Senate of Toronto University by the graduates in applied science.

Mr. J. W. Linden, chief electrician of the Owen Sound Electric Light Department, assumed the responsibility of wedded bliss last month. The ELECTRICAL NEWS joins with his many friends in extending congratulations.

Mr. D. E. Blair, superintendent of rolling stock for the Montreal Street Railway Company, was married at Quebec September 28th last to Miss Gertrude E. Evans, daughter of Mr. E. A. Evans, manager of the Quebec Railway, Light & Power Company. The employees of the Montreal Street Railway presented Mr. Blair with a silver tea set.

The many friends of M. D. A. Starr, who was for a number of years chief selling agent for the Royal Electric Company, will be pleased to learn that since leaving Canada his successful career in the electrical field has not been broken. He is now general manager of the Clyde Valley Electrical Power Company, of Glasgow, Scotland. In a letter to the ELECTRICAL NEWS Mr. Starr states that the company have a very extensive area under their exclusive control for the supply of power, etc, comprising some 734 square miles, with Glasgow as a centre. One or two of the large corporations, such as Glasgow and Paisley, are not included in their incorporation, as they already had large plants installed prior to the formation of the Clyde Valley Electrical Power Company. The company are constructing two very large power stations, one of which is expected to be completed by the end of the year, and the other one very shortly afterwards. One is located at Yoker, about seven miles west of Glasgow, the other at Motherwell, about fourteen miles east of Glasgow. All the distribution is underground, but it is intended to generate three-phase 25 cycle A. C. current at a pressure of 11,000 volts. The equipment will include Westinghouse-Parsons steam turbines and turbo-generators direct-connected, and boilers with the most modern steam auxiliary appliances. The capacity of each of these power houses will be in the vicinity of 20,000 h.p., and it is proposed to construct several more in the near future to cover different areas. The power houses will be models in the way of substantial construction and ornate inside equipment. There is a large demand for power, some customers requiring as much as 3,000 to 5,000 h.p. each, the location being right in the centre of the greatest industrial district of Great Britain.

TRADE NOTES.

The Scott & Hudson Building Company, of Rat Portage, Ont., have installed a 30 h. p. Westinghouse motor.

The Jones & Moore Electric Company are installing a complete electric light plant for the Collingwood Furniture Company, Collingwood, Ont.

The Whaley Automatic Smoke Prevention & Fuel Saver Company are about to install smoke consumers in the municipal power house at Goderich, Ont.

The Georgian Bay Engineering Works, Midland, Ont., have recently installed an electric-lighting plant, consisting of a Jones & Moore direct current generator, capable of carrying 150 lights.

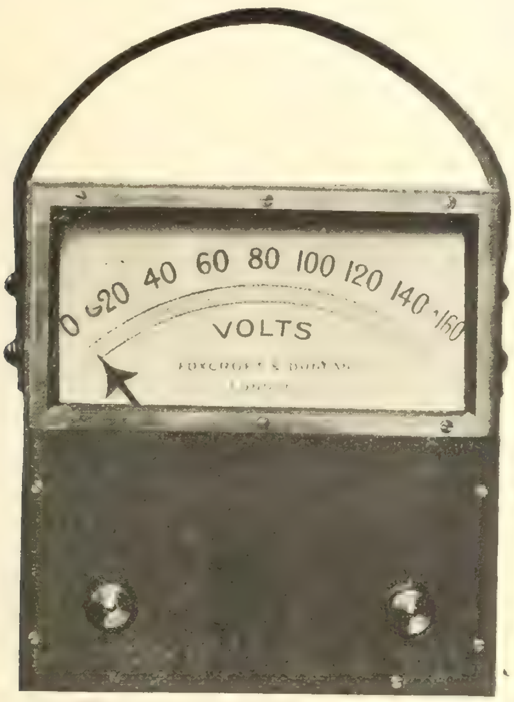
The Wm. Kennedy & Sons Company, of Owen Sound, Ont., are manufacturing eighteen head-gate winches for the Hamilton Cataract Power Company's plant at Power Glen, Ont. They are also building a special device designed to close the head-gates in the event of a sudden escape of water.

The machinery firm of G. S. Sinclair & Sons, Wiarton, Ont., has been turned into a joint stock company, with a capital of $40,000. Mr. Sinclair is president of the new company, whose specialty is the Sinclair patent coupling. They contemplate building a larger shop and installing special machinery for the manufacture of this coupling.

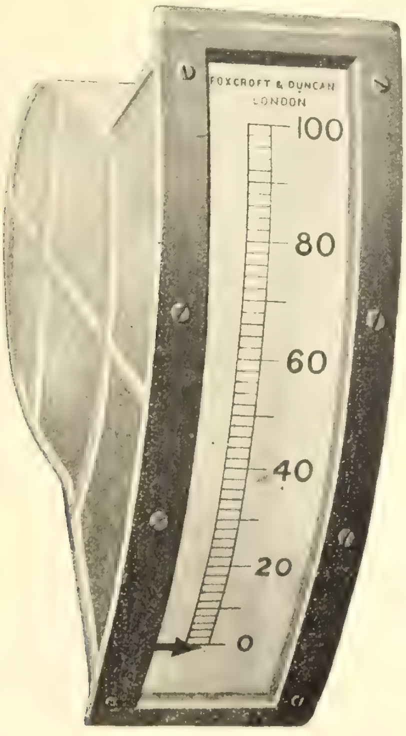
The business of the Stilwell-Bierce & Smith-Vaile Company, manufacturers of hydraulic machinery, etc., Dayton, Ohio, has been acquired by Colonel J. D. Platt, president of the Barney & Smith Manufacturing Company. Colonel Platt has organized a new company to be called the Platt Iron Works Company, and to have a capital of $400,000. The unfinished contracts of the Stilwell-Bierce & Smith-Vaile Company will be taken over.

ELECTRICAL MEASURING INSTRUMENTS.

Messrs. Foxcroft & Duncan, Queen's Road, Dalston, London, England, are well-known manufacturers of electrical measuring instruments. The first illustration represents their portable type. The "Permanent Magnet" instrument is most suitable where a cheap and reliable testing instrument is required, and is specially recommended for low readings. It is direct reading and is provided with adjusting screws for re-calibration. It has a silvered dial with white enamelled porcelain on copper, the needles deflecting in both directions from a central zero, but can be made with side zero if required.



The moving coil "Dead-Beat" type is a much higher class instrument and is more suitable for the higher ranges where extreme accuracy is required. It has a silvered and engraved dial equally divided up the whole range. It is extremely accurate, there being no hysteresis error, and is perfectly "dead-beat". It can be calibrated with a set zero or to start from 0, and can be arranged to read from a central zero in either direction, if desired, without extra charge. The shunt is contained in the same case as the instrument up to 250 amperes, making it a most compact instrument for testing purposes.



The above mentioned instruments are supplied in portable teak case with strong leather handle.

The "Edgewise" instruments, one of which is shown in the second illustration, are very suitable for main switchboards, and effect a great economy in space. They are mounted in painted cast-iron cases with nickel or coppered fronts and enamelled card scales with exceptionally bold figuring to enable them to be suitably fixed on the top or front of switchboard, as desired.

AN ECONOMICAL ARC LAMP.

So rapidly is the field of electric lighting being developed that information concerning the most successful lighting appliances is becoming of greater interest throughout Canada, and in this connection the Jandus interchangeable arc lamp, sold in Canada by the Packard Electric Company, of St. Catharines, is commanding much attention. This lamp has practically instituted a revolution in arc lighting and is of exceptional merit because of its adaptability to many uses. Among the many strong points of excellence the following are some for which convincing claims are made: One lamp interchangeable for all circuits, individually superior burning qualities, long life, quickest trimmed, low expense for carbons and trimming, compact and neat appearance, uniform 12-inch upper carbon trim, handsome ornamental case of colonial design, accessibility of parts for inspection, nonbreaking inner globe that is easily cleaned, etc.

The Packard Electric Company have recently prepared a special pamphlet describing the Jandus arc lamp in detail which will be of interest to every arc lamp user. This pamphlet they will be pleased to send free upon application.

JANDUS INTERCHANGEABLE ARC LAMP.

WORLD'S FAIR HONORS.

The Allis-Chalmers Company advise us that they have swept the field by winning the highest honors at the St. Louis Exhibition with each of their three exhibits: Steam engine, electrical and mining.

The five thousand horse power engine, popularly known as the "Big Reliable," and the huge generator built by the Bullock Electric Manufacturing Company, each won a grand prize. These two machines, forming the huge unit which supplies the world-famous decorative lighting of the Exposition buildings and grounds, and which have never failed under the most frequent and most unexpected emergency loads, are so well known as the dominating features of the machinery section of the Exposition that it is unnecessary to describe them again.

The Bullock Electric Manufacturing Company's grand prize also covered all their alternators, synchronous motors, direct current generators and motors and rotary converters. This award is a significant tribute which must interest all users of electrical machinery. In addition to all this the Bullock system of multiple voltage control of motors won a gold medal.

SPARKS.

Marcelin Tremblay has registered as proprietor of the Dominion Electric Company, Montreal.

The ratepayers of Palmeston, Ont., carried a by-law a fortnight ago to raise money to extend the electric light plant.

Mr. Roy Scott, who has been in charge of the electric light plant of Seaforth, Ont., for the past two years, has accepted a responsible position in Winnipeg.

The by-law confirming the agreement with the Ottawa Electric Company for the lighting of the streets of Ottawa for a period of ten years has been signed by the mayor.

The Council of Paris, Ont., have passed a by-law providing for the issue of debentures to the amount of $10,000 for the purpose of extending and completing the electric light plant.

Owing to inability to make suitable arrangements with property owners, the Belt Line railway project for an electric road from Walkerville to Sandwich, Ont., may be abandoned.

The Electric Water Heater Company, Limited, has been incorporated at Victoria, B.C., with a capital of $50,000, to acquire the patents of and manufacture the Instantaneous electric water heater.

The Incline Railway Company have asked the City Council of Montreal for an extension of their franchise for twenty-five years and for permission to construct an electric railway on the Mountain.

Mr. F. A Cambridge, city electrician of Winnipeg, Man., has recommended that the wires for the fire alarm system be placed underground and that the laying of conduits be undertaken before the proposed paving work is proceeded with.

The Nelson Electric Tramway Company, Nelson, B.C., is negotiating with a view to disposing of their road to the Town Council. The power for the operation of the road is obtained from the West Kootenay Power & Light Company.

The Algoma Power Company, Limited, has been incorporated at Berlin, Ont., to construct works for the production of electricity. The capital of the company is $100,000, and the directors are Messrs. D. B. Detweiler, Oliver Kinzie, N. B. Detweiler and C. K. Hagedorn, all of Berlin.

The Cranbrook Herald states that the Bull River Falls Power & Light Company have secured a unique location for their water power plant, and that a 10,000 h.p. development is contemplated. A market for the power will be furnished by the mining operations which are being carried on in the Southeast Kootenay district.

The Council of the City of Revelstoke, B.C., have spent about $9,000 this fall in improving the water system, and now have an adequate fire protection supply, which has long been needed. The improvements, we are informed, were paid for entirely out of the profits from the light and water systems owned by the City, and which will amount to about $12,000 for the year.

The Fort William, Loch Lomond and Mount McKay Incline Railway & Tourist Resort Company will apply to the Ontari Legislature for incorporation, to construct and operate an incline railway from a point on the Kaministiquia river up Mount McKay, also to construct an electric railway from Loch Lomond to a summer resort to be established in the vicinity. Messrs. Watson, Smoke & Smith, Toronto, are solicitors for the company.

The Electrical Development Company are about to call for tenders for their new power house to be built at Niagara Falls, Ont. They have just awarded contracts aggregating about $120,000 for a new subsidiary power station at that place, the concrete and brickwork going to Mr. Thomas Mumford, of Niagara Falls, and the steel work to the Canada Foundry Company, of Toronto.

The Owen Sound Electric Light Department have recently replaced their old generators with two new machines made by the General Electric Company, of Sweden. One is placed in the steam power house and the other at the water power plant. The generators are direct connected with the engines and have sufficient capacity to carry about 3,000 16 c.p. lights, against 1000 with the old plant.

Mr. John Galt, C.E. & M.E., of Toronto, has awarded the following contracts in connection with the waterworks and electric light plants for the village of East Toronto: Generator, Allis-Chalmers Bullock, Limited, Toronto; engines, Goldie & McCullock Company, Galt; induction motors, transformers, steel tanks and pumps, Canadian General Electric Company and Canada Foundry Company, Toronto.

The new water-power plant at Niagara Falls, Ont., will have to contend with the greatest enemy of Canadian water-powers, floating and anchor ice, and Mr. R. S. Kelsch, of Montreal, has spent considerable time at the Falls, recently, studying this matter. Mr. Kelsch's experience at Lachine Rapids, and the successful means employed to overcome the great difficulty experienced by the Lachine Company, will be of great assistance in formulating successful plans for handling ice at Niagara Falls.

We are pleased to learn that the International Jury in Group III., Higher Education, Technical Schools, etc., of the St. Louis World's Fair, has awarded a bronze medal to the Thomas S. Clarkson Memorial School of Technology, of Potsdam, N. Y. The exhibit was warmly commended by the members of the jury and was a source of interest to visitors throughout the summer. The principal of this school is Mr. Aldrich, who is well known to many Canadians.

It is understood that plans have been completed for the new power house for the Southwestern Traction Company, and that the work of construction will be commenced as soon as the site is decided upon. Two locations are under consideration—one at Lambeth, the other near St. Thomas. The station is estimated to cost about $200,000 and will furnish power for the operation of thirty miles of electric railway between London and St. Thomas. Mr. A. E. Welch, of London, is manager of the company.

Mr. J. Burtt Morgan, promoter and general manager of the Chilliwack Light & Power Company, of Chilliwack, B.C., speaks very hopefully of the enterprise of that company. Their franchise on the Chilliwack river will give them 3,000 horse power. The intention is to distribute electric energy for lighting purposes and to build and operate an electric railway from the town of Chilliwack to the city of New Westminster. The development of the valuable mining properties in the Mount Baker district is calculated to open up a large market for power, as most of these mines are within fifteen miles of the proposed site of the power house.

The Montreal Light, Heat & Power Company have closed a contract with the Montreal Street Railway Company for 7,000 additional horse power, making a total of 12,000 horse power purchased by the Montreal Street Railway Company from the Montreal Light, Heat & Power Company. The power is delivered at 60 cycles, three phase, 2,200 volts, 24 hours per day. This is an important contract, involving the sum of five million dollars. The contract is for a period of twenty-five years, with option of renewal, and was prepared by Mr. R. S. Kelsch, consulting engineer for the Montreal Light, Heat & Power Company, and Mr. R. D. Mershon, consulting engineer for the Montreal Street Railway Company.

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SPARKS.

The Slade Electric Company, manufacturers of electrical supplies, Quebec, has been dissolved.

R. Kinsey has been granted water concessions in Lamb Creek by the British Columbia Government and is taking steps to develop 550 horse power of electric energy.

Work is progressing on the new power house of the Winnipeg General Power Company at Lac du Bonnet, Man. The development will be 20,000 h.p., which it is intended to transmit to Winnipeg. The power house will be of brick, 500x50 feet, and will provide accommodation for nine generators.

Incorporation has been granted to the General Illuminating Company, Limited, of Ottawa, to generate and distribute gas and electricity for light, heat and power. The capital stock is $50,000. Messrs. E. H. Bronson, F. P. Bronson, W. G. Bronson, Levi Crannell and E. E. LeSueur are the promoters.

Messrs. Wm. Shaw, locomotive engineer, George B. Baby, electrician, and others, of Hamilton, have organized the Anyun Fuse & Electric Company, Limited, to manufacture electrical and mechanical supplies and apparatus, including the Anyun oil fuse and fuse boards. The nominal capital is $40,000.

The Sarnia Gas & Electric Company, of Sarnia, Ont., have recently completed a new chimney for their plant. It is of red brick, built on a concrete foundation 9x17 and is 12 feet 6 inches square at the base, continuing the same form and dimensions to a height of 28 feet. Above that it is of octagonal form for 97 feet, with an outside diameter at the top of 11 feet. It is finished with a cement cap, making the total height from foundation 125 feet. It is provided with a double wall to the height of 74 feet 10 inches. The inside diameter is practically 6½ feet throughout the entire pipe.

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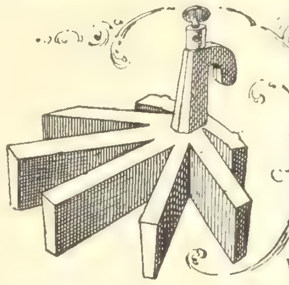

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SPARKS.

Messrs. Hamilton & Prout have been given a renewal for five years of their contract for lighting the municipality of Forest, Ont.

Messrs. Musgrove, Vrooman & Lee, of Chicago, have applied to the Northwest Legislature for an ordinance to incorporate the Continental Electric Company, Limited, with power to manufacture and deal in electrical and other machinery, with headquarters at Regina, N.W.T. Messrs. Mackenzie & Brown, of Regina, are their solicitors.

The British Columbia Electric Railway Company is having incorporated another subsidiary company similar to the Vancouver Power Company. It will be known as the Victoria Power Company, and will have a capitalization of $750,000. The scheme contemplated is to dam the Koksilah river or any of the small lakes therein and to divert the water into Shawinigan Lake, across the outlet of which a small weir is to be constructed to regulate the flow of water from the lake and to conserve it for dry seasons. The water will be conveyed to Mill Bay, on Saanich Inlet, where the power house will be located. The power will be used for industrial, lighting and street railway service in Victoria and Esquimalt. The work will be started as soon as possible and will probably occupy about two years. The British Columbia Electric Railway Company have made a proposition to the C.P.R. to operate the Vancouver and Lulu Island Railway by electric energy, but no decision in this matter has yet been announced.

ELECTRICAL REPAIRS

In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

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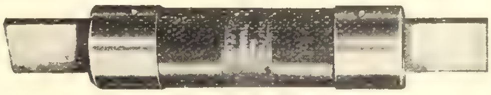

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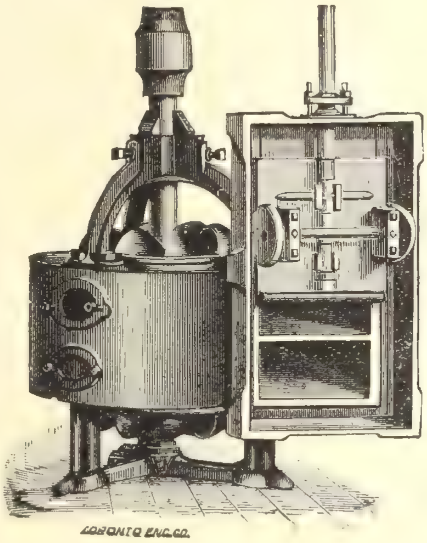

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SPARKS.

The improvements to the electric light plant at Almonte, Ont., are now practically completed.

Negotiations are said to have been concluded for the extension of the Winnipeg electric railway through St. Boniface and Kildonan to Bird's Hill. The company propose to build two miles of the road the first year, one mile the second year and to complete it the third year. Work will be commenced early next spring.

The Ottawa & Hull Power & Manufacturing Company have closed a contract to furnish The International Portland Cement Company 3,500 horse power. The power will be delivered to them 10,000 volts, three phase, 60 cycles. The contract is for a period of ten years with option of renewal, and was prepared by Mr. R. S. Kelsch, consulting engineer, Montreal.

According to the franchise recently given to the Eau Claire Light & Power Company, the city of Calgary, N.W.T., secures eighty-five 1,200 candle-power lamps at $80 per lamp, to burn all night. The contract continues in force for five years and is renewable at expiration for an additional period of five years. At the end of the first term the city has the privilege of purchasing the plant at the original cost, nothing to be allowed for depreciation of the plant during the time. Mr. Prince, the manager, is now busily engaged in installing the new arc plant, which will be kept separate from the commercial plant so that it can be turned over to the city if desired.

Mr. R. S. Kelsch, consulting engineer, Montreal, has returned from Vancouver Island, B. C., which place he visited in connection with a hydro-electric development to cost $2,000,000. The property is controlled by Montreal capitalists. The transmission will be 56 miles at 60,000 volts.

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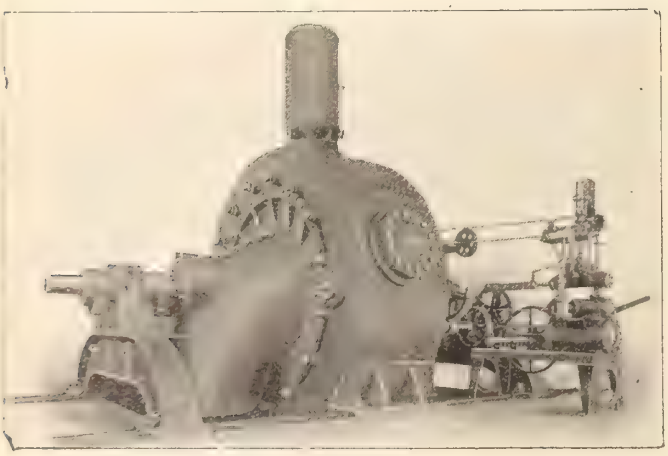

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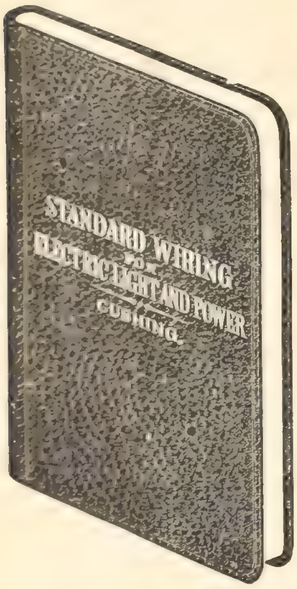

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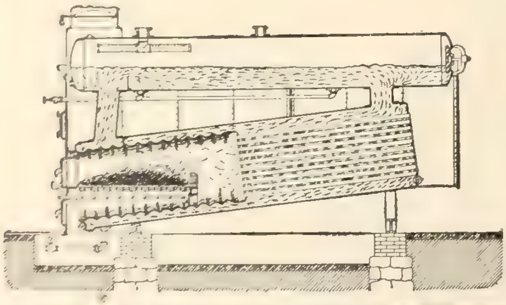

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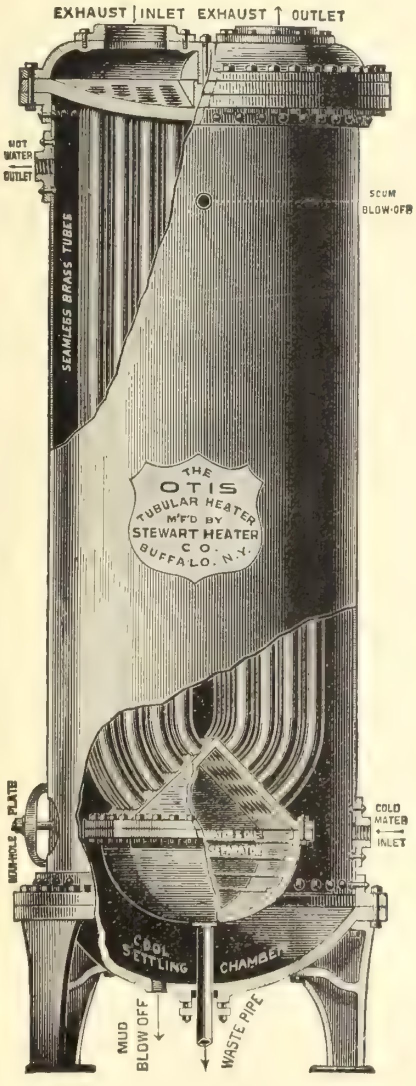

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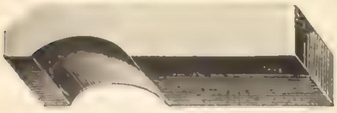

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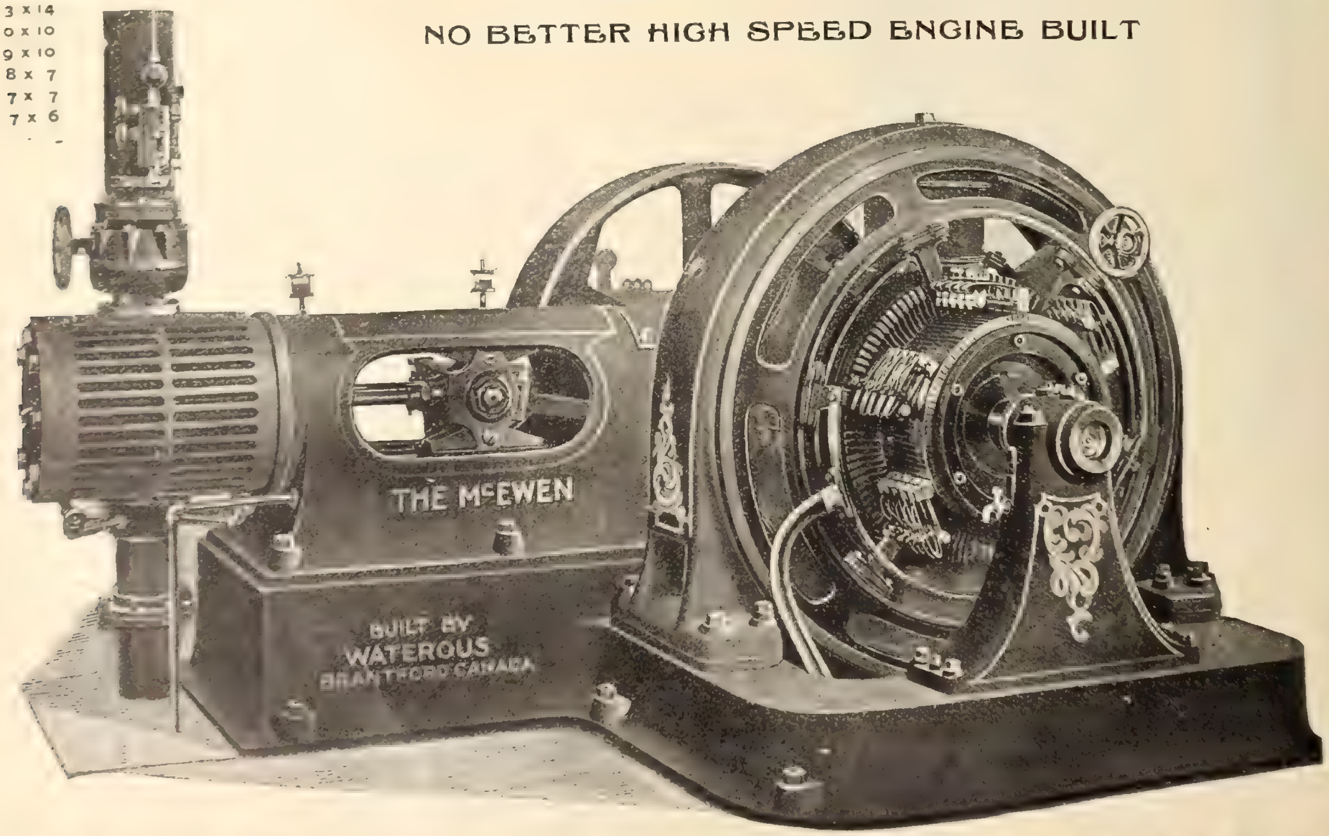

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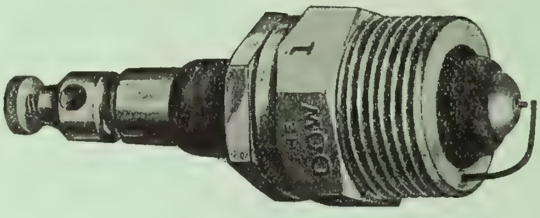

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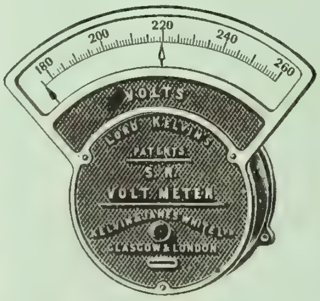

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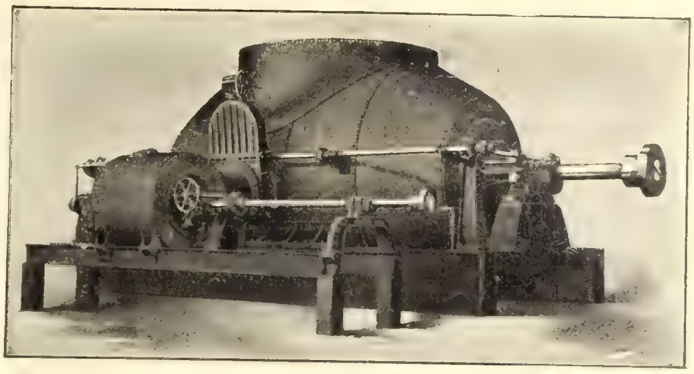

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TELEGRAPH and TELEPHONE

Mr. Peter Tansley has been appointed manager of the Bell Telephone Company at Wingham, Ont.

The City Council of Edmonton, N.W.T., have purchased the Edmonton District Telephone Company's lines for $17,000.

The Bell Telephone Company have built a new line from Toronto to Berlin and intend extending it to Stratford and London.

The International Telephone Manufacturing Company, of Chicago, have reconstructed the telephone system at Neepewa, Man.

The Bellechasse Telephone Company are extending their lines throughout the county of Lotbiniere and adjoining counties in Quebec.

Mr. D. V. Mott, who has secured a telephone franchise at Fernie, B.C., has promised that the rates will not be more than $3 per month for business places and $2 for residences.

The proposition made by the Stark Telephone Light and Power Company, of Toronto, for installing their system at Brantford, Ont., was rejected by the City Council on November 21.

The Rainy River International Telephone Company has been incorporated at Rainy River, Ont., with a capital of $250,000, the directors including Messrs. D. Robertson, P. T. Roberts and J. A. Mathieu.

The storm in the Eastern States and the Maritime Provinces about the middle of November laid 130 miles of telegraph and telephone poles to the ground between Lakeview, Maine, and Tracey, N.B.

Mr. H. E. Brockwell, superintendent of the Bell Telephone Company, Winnipeg, recently delivered an interesting lecture in the Y.M.C.A. Auditorium in that city on "Magnetism and Electro-Magnets."

The Deer Island Telephone Company, unable to make arrangements with the New Brunswick Telephone Company, have laid a cable at Kendall's Head and connected with the lines of the Forest Telephone Company.

Mr. Alex. Renshaw, who for the past sixteen years has been agent for the Great Northwestern Telegraph Company at Berlin, Ont., has resigned that position to accept the secretaryship of the Berlin Light Commission.

Mr. Potts Hubbard, 449 Main street, Winnipeg, has given notice that application will be made to the Legislature for the incorporation of a telephone company to construct and operate local and long distance telephone lines within the province of Manitoba.

An agreement for an exclusive franchise for five years has been reached between the Bell Telephone Company and the City Council of Kingston, Ont. The city is to receive $700 per year, free use of the poles for fire alarm wires, telephones to citizens at $40 for business and $25 for residences, two party lines for residences at $18 each and four at $15.

Prof. Braun, of Strassburg, the well known inventor of one of the German wireless systems, spoke at the convention of the German Society of Naval Architects at Berlin on the new method and the aims of wireless telegraphy. The professor affirmed that the problem of directing an electric wave exclusively to one point of the compass was possible of solution, but they must proceed by creating electric energy at points along the same line.

The Peterboro Light & Power Company purpose advancing their price for current. Hitherto they have supplied customers at a flat rate of $1 per light per year. Meters are to be used in future and the charge will be 7½ cents net per 1,000 watt hours.

It is expected that by next spring the water power now being developed on the Wahnapitae river, near Sudbury, Ont., will be completed and the company will be delivering power. The town of Sudbury will take electric power to run its light plant and waterworks, and it is probable that the Mond Nickle Company will also take power for their mines and reduction works.

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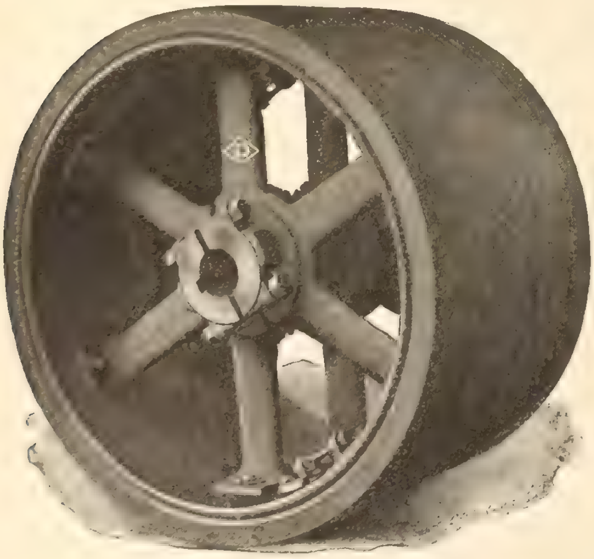

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TORONTO MONTREAL

SPARKS.

The Town Council of Wolfville, N. S., are moving in the direction of installing an electric light plant in addition to the plant already in operation.

A by-law will be submitted to the ratepayers of Calgary, N. W. T., on December 20, to raise $60,000 to install a municipal electric light plant.

Messrs. Ahearn & Soper, of Ottawa, have been awarded the contract for electrical supplies for lighting the Welland canal, the consideration being about $60,000.

The Babcock & Wilcox Company, of Montreal, have been awarded the contract for supplying the boilers for the new C. P. R. Hotel in Winnipeg. The contract is worth about $9,000 and was secured through their Winnipeg representative, Mr. J. C. Gibson.

The Intercolonial Railway authorities are installing the Hughes electric switch circuit brake at various points along the road to prevent accidents from open switches. The invention is the work of two employees of the Intercolonial Railway and is pronounced by railway men to be practical and efficient.

By a large majority the ratepayers of Westmount, Que., on December 3, voted in favor of installing a municipal electric light and incineration plant. The town has hitherto obtained its electric light supply from the Montreal Light, Heat & Power Company.

The Gould Storage Battery Company, of Depew, N.Y., have just installed a storage battery plant for the Preston and Berlin Street Railway Company. The battery is 230 cells, there being thirteen plates 10½ x 10½ inches, which will give a line voltage of 480 volts normal load, or a capacity of 280 h.p. per hour.

Mr. W. McLea Walbank, of Montreal, has advised the Town Council of Morrisburg, Ont., that the best location for a power house would be in the vicinity of the present pumping plant, the walls, flumes, etc., to be built of concrete and steel, with a brick turbine shed and power house containing five 60-inch wheels,one 45-inch exciter wheel, generator and switchboard.

Dr. A. I. Mader sued the Halifax Tramway Company for $10,000 damages for injuries snstained last February by being thrown from a sleigh, he alleging that the accident was caused by a ridge formed by the Tramway Company's sweeper throwing snow on the track. The jury awarded him a verdict of $7,372.40, of which $3,000 was for permanent injuries and general disability for life. The jury considered that the company did not exercise reasonable care in regard to the condition in which they left the street.

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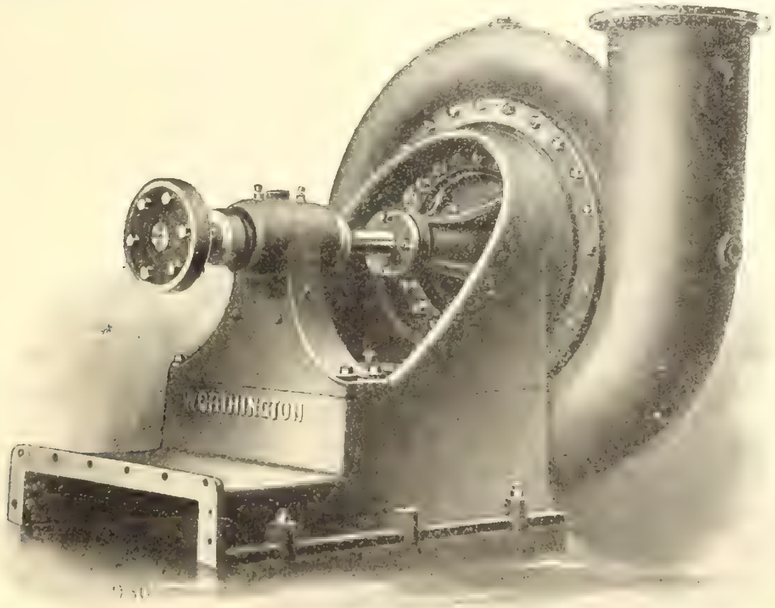

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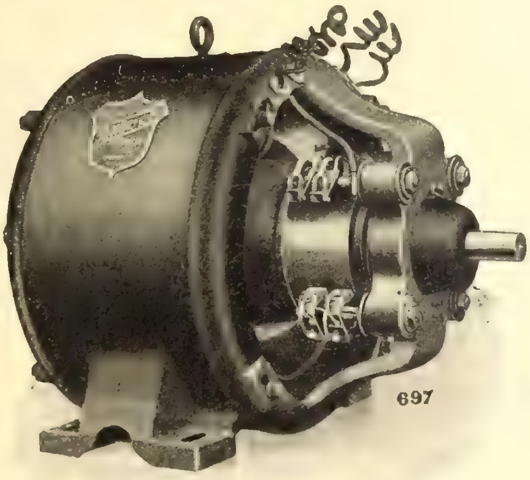

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AND
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PERSONAL.

Mr. George Benson Baby, late managing director of the Anvun Fuse and Electric Company, Limited, Hamilton, Ont., has severed his connection with the above company and commenced business as an electrical contractor, with headquarters at 6 York street, Hamilton.

Mr. Charles F. MacGill, long and favorably known as mechanical superintendent of the Canadian General Electric Company at Peterboro and the Canada Foundry Company at Toronto, has accepted the position of general superintendent of Carrier, Laine & Company, Levis, Que. Mr. MacGill has been in Canada about six years, and previously was connected with some of the best concerns in the United States, notably the General Electric Company and the Westinghouse Company.

The Hamilton Street Railway Company have appealed from Justice Street's judgment in favor of the city in the limited ticket case. They have secured permission to carry the case straight to the court of appeal.

The lighting company at Wallaceburg, Ont., has transferred its interest and franchise to a new company, to be known as the Wallaceburg Electric Light and Power Company. The officers are: President, W. D. McRae; vice-president, D. C. McDonald; secretary-treasurer and manager, Hugh Stonehouse.

An interesting experiment was recently made on the Niagara, St. Catharines and Toronto Railway of an invention designed to obviate the possibility of accidents from the disregard of signals. The inventor is Mr. James Doyle, of Niagara Falls, N.Y. Beside the railway track just outside the semaphore is placed a small machine called the brake trip, which strikes a projection on the brake on the passing engine and sets the brake, which opens the air valve on the engine and shuts off the steam. The brake trip is set to strike the brake on the engine only when the semaphore is down, or closed. A large number of prominent railroad men from the United States and Canada witnessed the experiments, which are said to have been very successful.

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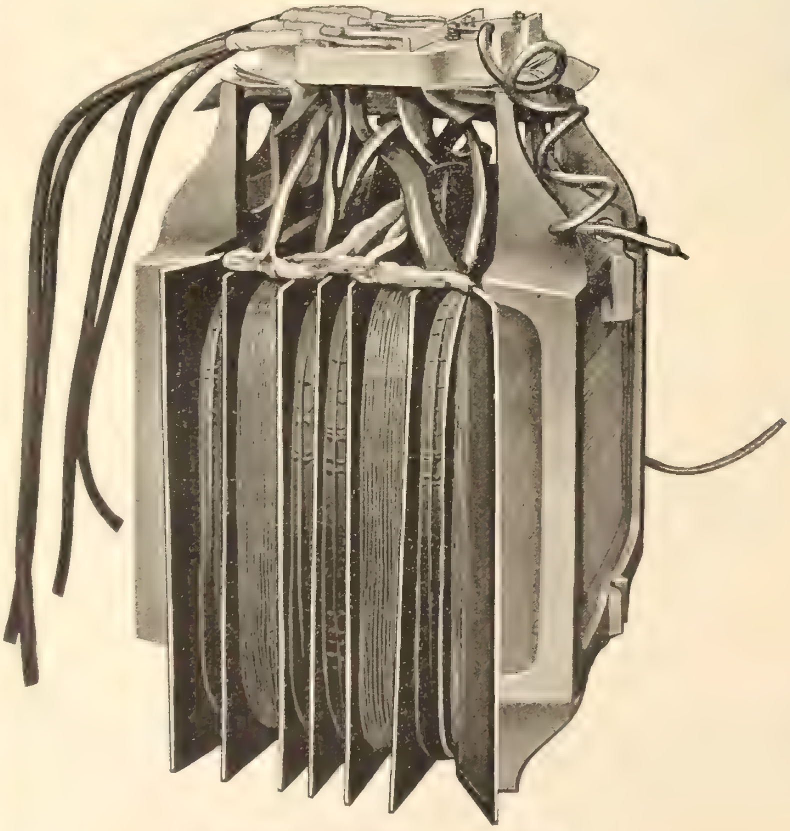

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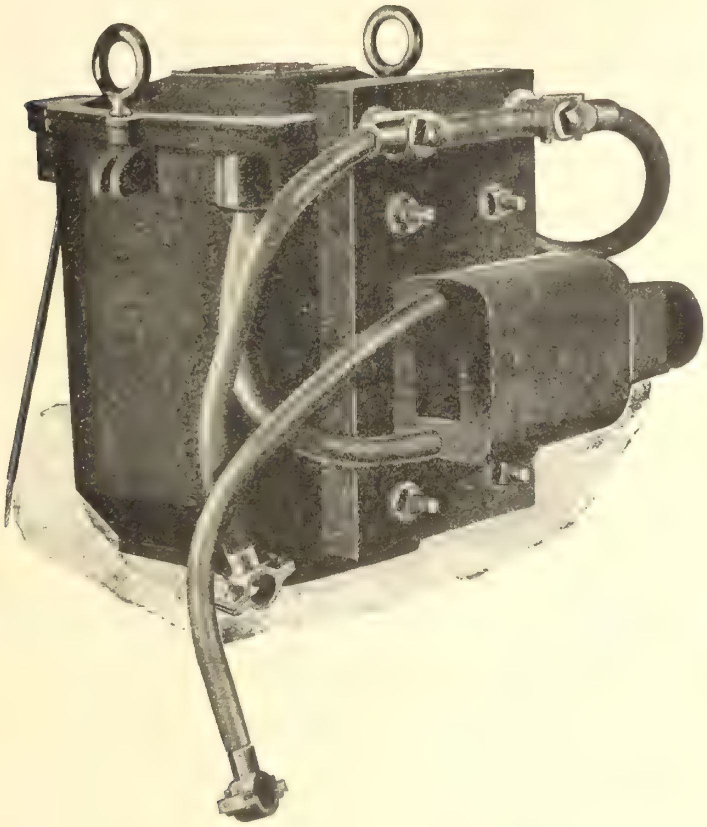

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When ordering this Outfit state how many printed circulars and envelopes you wish for mailing to your prospective customers, and how many placards you will require to hang in public places. The Pittsburgh Transformer Company will supply this material at cost.

Pittsburgh Transformer Company,

Pittsburgh, Pa.
Pittsburgh, December, 1904.

SPARKS.

The electors of Sussex, N.B., will likely be asked to approve of the building of a new electric light and waterworks station.

A by-law has been passed by the Council of Brandon, Man., granting certain privileges to the Western Electric Light & Power Company.

The Canadian Westinghouse Company, Limited, has sold to the Hamilton Cataract, Power, Light and Traction Company, for use in their Victoria sub-station at Hamilton, Ont., two motor-generator sets, each consisting of a synchronous motor and a direct current generator. The motor-generator sets will be of the two-bearing type, the generators delivering direct current at 550 volts to the railway system, and each being rated at 750 k.w. The synchronous motors will take two-phase current at 8,000 alternations and 2400 volts, and will be rated at 1380 h. p. The excess of capacity in the motors is provided so that they may be used for raising the power factor of the transmission system. Power is taken through lowering transformers from the high tension transmission line from the DeCew Falls station of the company. These motor-generator sets will be built at the works of the Westinghouse Electric & Manufacturing Company at East Pittsburg, Pa.

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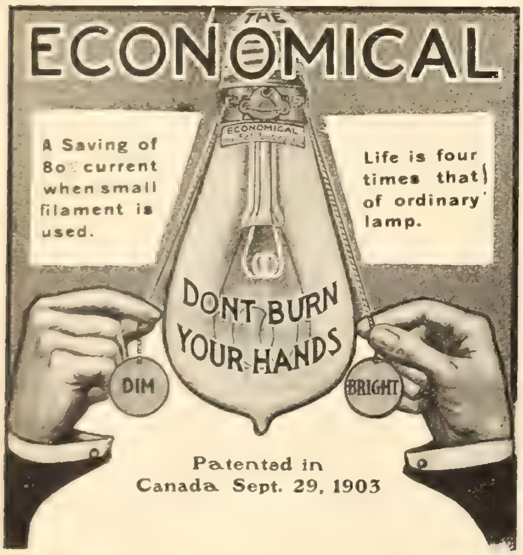
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"PULL STRING" TURN DOWN **LAMP**

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123 Liberty Street, New York, U. S. A.

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Gutmann Meters

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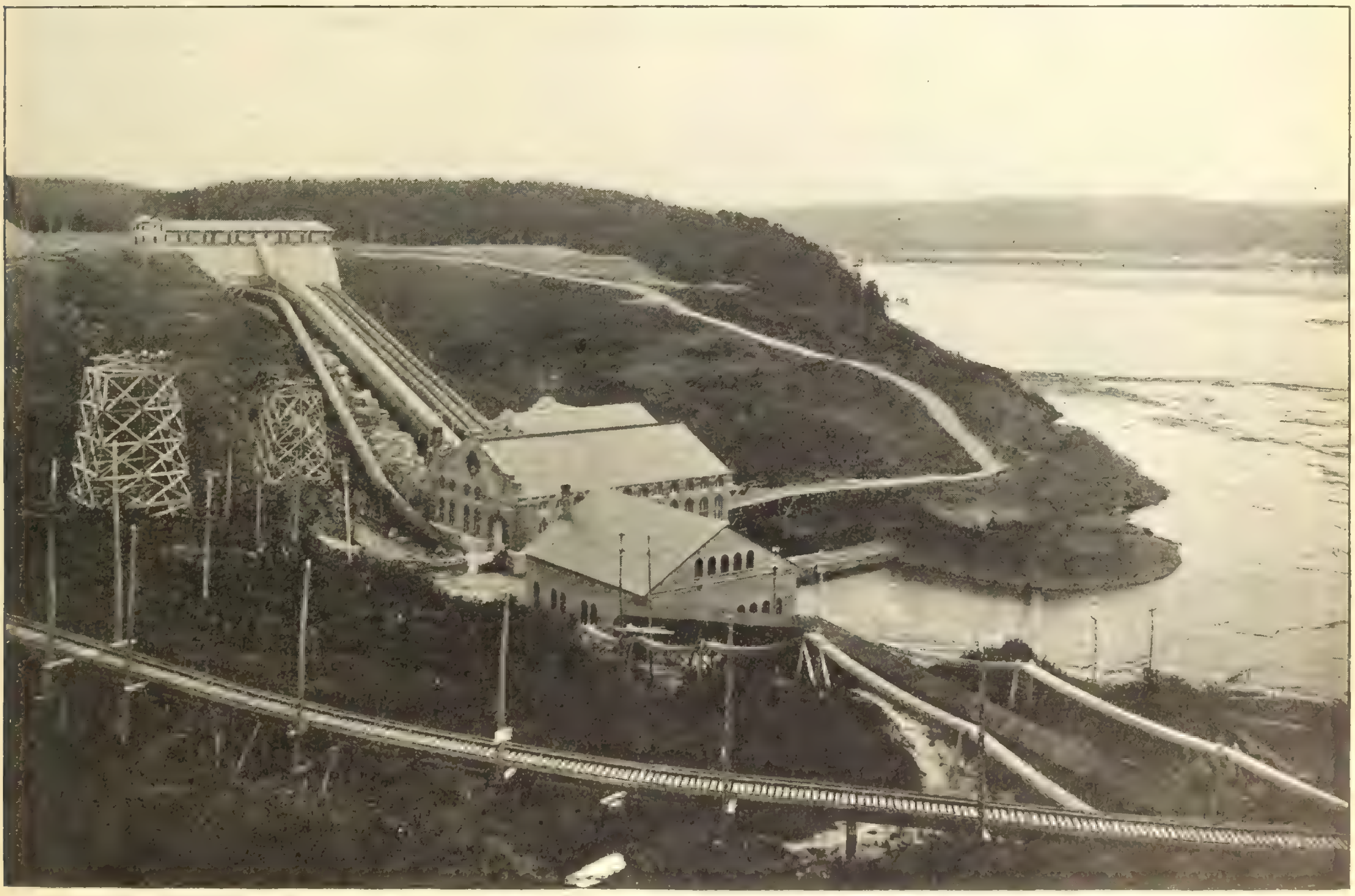
ELECTRICAL SUPPLIES - 708-710 Craig Street, MONTREAL

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIV. DECEMBER, 1904 NO. 12.

THE ELECTRIC POWER DEVELOPMENT AT SHAWINIGAN FALLS.

The longest electrical transmission line in operation in Canada is that of the Shawinigan Water and Power Company, delivering current generated at Shawinigan Falls to a terminal station in Montreal over a distance of ninety miles. Through the courtesy of the Company we are permitted to publish herewith a very complete and accurate description, with illustrations, of the property and plant of this Company, which we feel certain will be appreciated by all persons interested in power development and transmission.

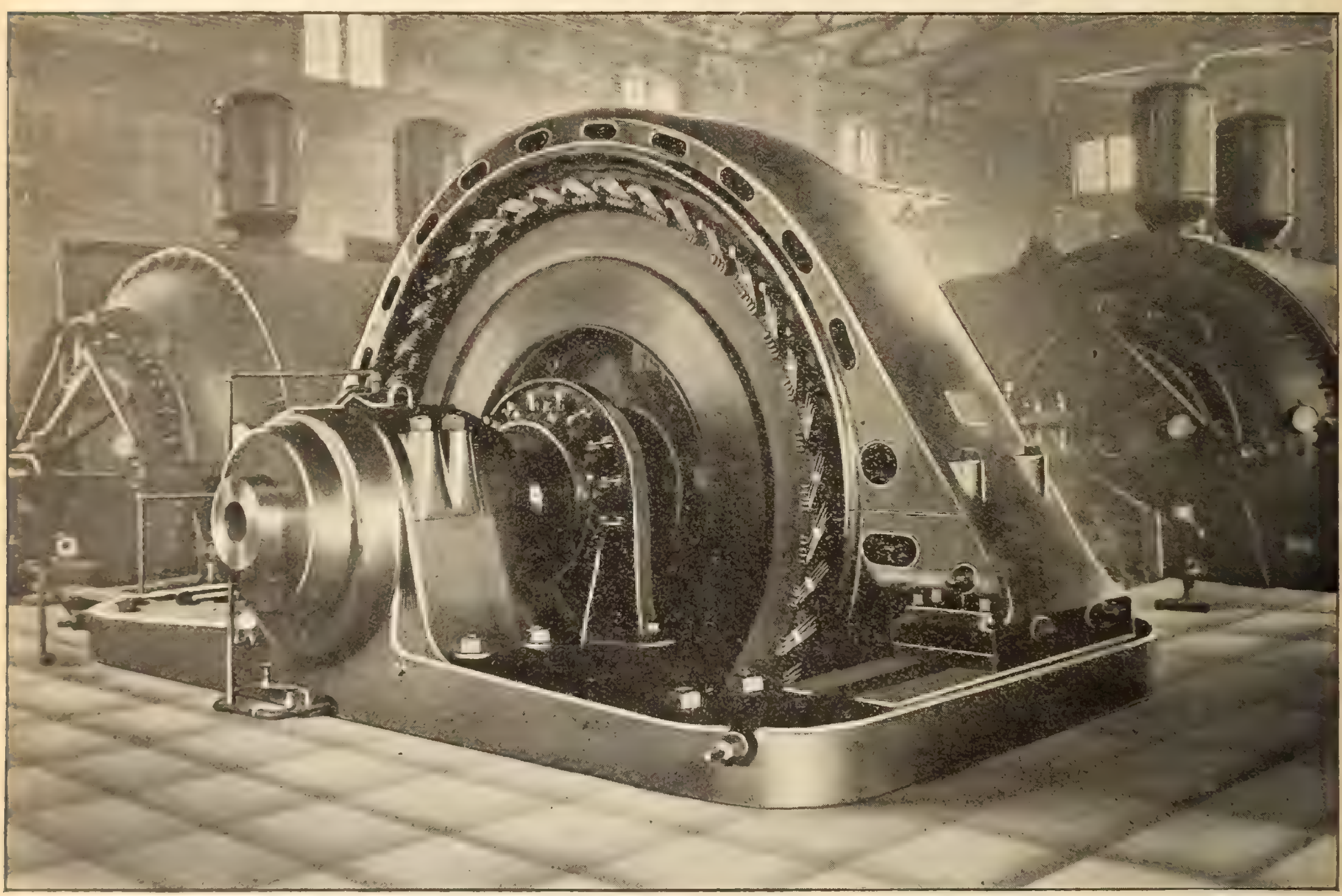


SHAWINIGAN WATER & POWER COMPANY—GENERAL VIEW OF POWER DEVELOPMENT.

The Company purchased from the Provincial Government of Quebec all of its property at Shawinigan Falls, including the water-power of the St. Maurice River at this point. The real estate acquired from the Government comprised eleven hundred acres, and the ownership of this property gives absolute control of Shawinigan Falls, in the St. Maurice River—one of the greatest natural water-powers in existence, the river at this point falling a distance of over one hundred and fifty feet.

The St. Maurice River—one of the largest rivers in Canada—has its source at the divide between the valley of the St. Lawrence and the valley of the Hudson Bay, at a point about three hundred miles north of Shawinigan Falls. It drains an area of about eighteen thousand square miles. Practically all of this area is now forest, and, most of the country not being suitable for agriculture, is likely to remain timbered for many years. This whole area is thickly interspersed with lakes, so that the flow of the stream is naturally more constant than most rivers of its size. For a distance of some four miles above the falls at Shawinigan the river broadens out and is practically a lake. At the foot of the falls is another large lake, the difference in level between the two being about one hundred and fifty feet. The fact of the existence of this lake above the falls is of great importance in that it serves as a reservoir in which the frazile and anchor ice, formed in the more rapid running water, is collected underneath the surface ice, with the result that but little reaches the falls. At the crest of the falls a ledge of rock forms a natural dam, the water directly above the crest being about twenty feet deep at ordinary stages of the river.

The first development was made by excavating a canal or forebay from a point near the crest of the falls, about one thousand feet to the west, the end of this canal being closed by a concrete wall, in which are the head-gates and the entrance to the penstocks. From the forebay-wall, penstocks about four hundred and fifty feet in length conduct the water to the power-house at the level of the lower lake. The canal is twenty feet deep at low water and one hundred feet wide, and of sufficient capacity to develop 75,000 horse-power. The excavation is entirely in granite rock. The forebay-wall is so constructed that it can be extended as required to utilize the full capacity of the canal.



Shawinigan Water & Power Company—One of the 3,750 K. W. Generators.

The power-house is constructed on solid rock, which was blasted to a depth of about twenty feet to provide proper tail-races for the discharge of water from the wheels. The building is of solid concrete construction up to the windows, and from that point the walls are of brick twenty-four inches in thickness. The roof is of slate, supported by steel trusses. The whole building is served by an electrically operated crane having a capacity of fifty tons.

In this power-house are now installed three units, each consisting of a pair of "Francis" turbines on a horizontal shaft, each pair of turbines being supplied with water through a penstock nine feet in diameter, and discharging through a central draft-tube, and each capable of developing 6,000 horse-power. To each of these three turbines is direct connected a 3,750-K. W., 2-phase, 30-cycle, 2,200-volt generator. Each unit operates at a speed of 180 revolutions per minute.

Two separate units are provided for producing the exciting current for the generators. These units consist each of a 500 horse power turbine, driving a 300-K.W. direct current generator, water being supplied from a separate penstock. Each of these units is sufficient to furnish exciting current for six generators. The governor is so arranged that it can be connected to either or both of these exciter-wheels. Auxiliary apparatus is operated either from 30-cycle induction-motors, or, in cases where such apparatus is needed to be operated independent of the large generators, from the exciter-units.

The current is taken from the exciters over aluminum bus-bars to the exciter switchboard, and from there distributed to the various generators.

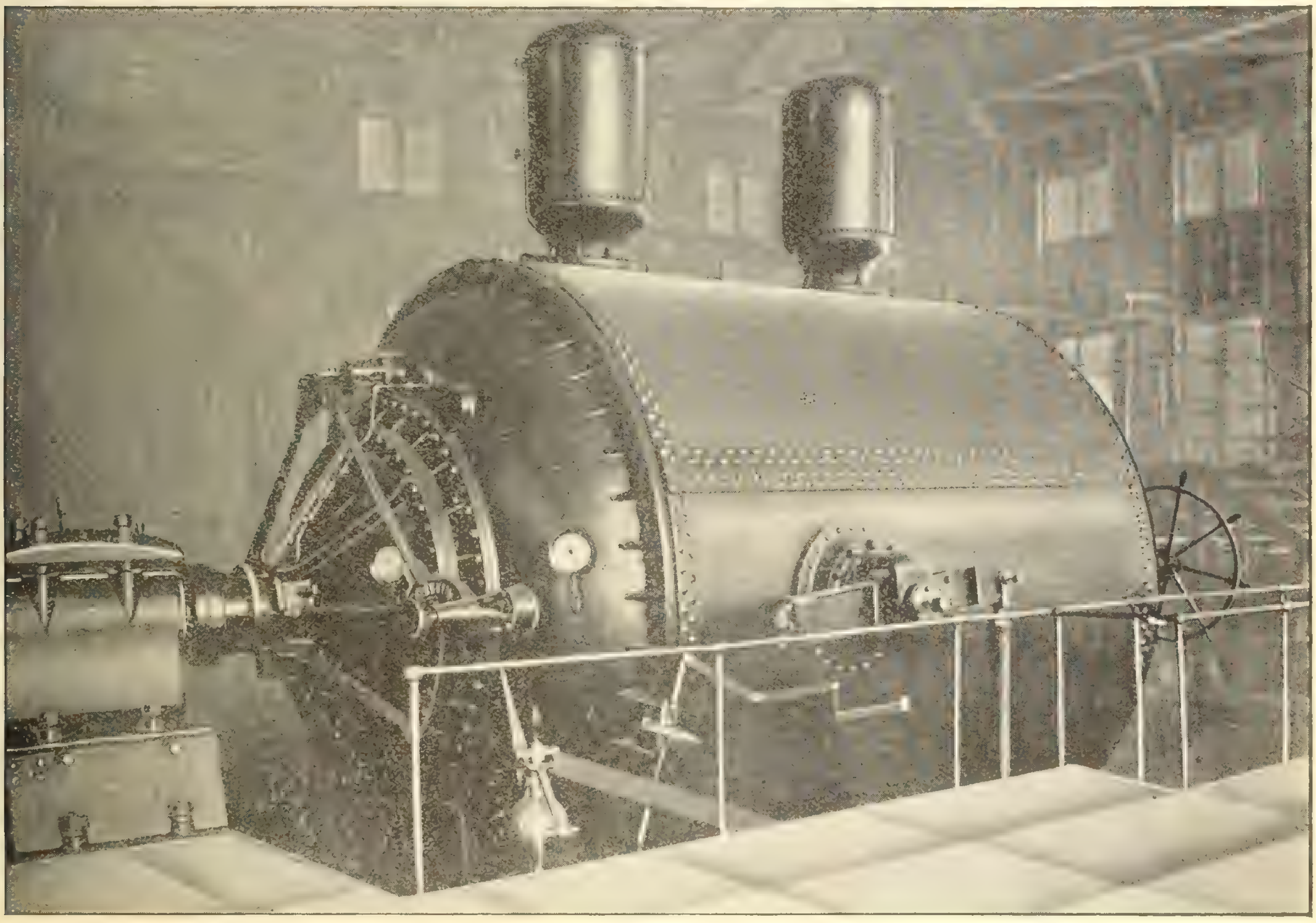
The current from the main generator is conducted through lead-covered cables laid in conduits to the four-pole electrically operated oil-switches, one switch being provided for each generator. The switches are of the solenoid type, and work very rapidly. No difficulty is experienced in synchronizing the generators with these switches. From the oil-switches the current is taken through lead-covered cables to the bus-bars. All cables in the power house are in fire-proof conduit, or are protected by barriers, so that in case of burning the adjacent cables would not be injured. Selector-switches are provided, by means of which the current from any generator can be taken to either one or two sets of bus-bars. The selector-switches are interlocking with the oil-switches ; the arrangement being such that the circuit must be opened and closed with the oil-switches. From one set of bus-bars current is taken to the local distributing-board, through which the 2,200-volt current is distributed to the eletcric lighting system, the water-works pumping station, and to small factories in the town of Shawinigan Falls. From this same set of bus-bars current is also taken to four 1,100-k.w. oil-insulated, water-cooled transformers, located in the transformer-house built parallel to the main power-house and on the side towards the forebay. In this transformer-house are also located the lightning arresters, static interrupters and high-tension switches for the 25,000-volt line, and also for the 50,000-volt line. From the four transformers above mentioned a 25,000-volt line is taken to the electro-chemical industries located in the north part of the town, about two miles from the power-house. Here are at present a company engaged in the manufacture of ferro-manganese, and using 1,200 horse-power ; also a calcium carbide factory of a capacity to utilize 5,000 horse-power. It is expected to extend this 25,000-volt line to points where power will be sold within twenty miles of the station.

Between each transformer and its bus-bar is an electrically operated oil-switch. Each oil-switch can be disconnected from the bus-bar by knife-switches.

From the second set of bus-bars current is taken to oil-insulated, water-cooled transformers located in the same tranformer-house described above, which step the current up to 50,000 volts for transmission to Montreal and other places at a distance from Shawinigan.

Both the power-house and the transformer-house at Shawinigan are of fire-proof construction, and the transformers are themselves protected from internal fires by means of a system by which, in case of the oil in the transformers being fired by internal short circuits, it will immediately be discharged from the transformers.

From the transformer-house a three-phase line of aluminum cable runs along the Great Northern and Chateauguay & Northern railroads to the company's terminal station in Montreal. This station has a capacity of over 10,000 horse-power, is built of steel and brick, and is fire-proof throughout. This transmission line is about ninety miles in length. At times of peak load the voltage between wire and wire reaches 56,000 volts.



Shawinigan Water & Power Company—One of the 6,000 H. P. Water Wheels.

The transmission line is three-phase, each wire being a stranded aluminum cable composed of seven No. 6 B & S wires. These wires are spaced sixty inches apart, in the form of an equilateral triangle, with the apex above. The power-line is transposed twice in its entire length, each transposition being one-third of a complete turn.

A private telephone line is strung on the same poles as the power line, the telephone wires being five feet from the nearest power wire. The telephone wires (No. 9 iron) are mounted on 10,000-volt insulators, and are transposed every 1,800 feet. This line gives good service, being only slightly affected by the neighboring power circuit.

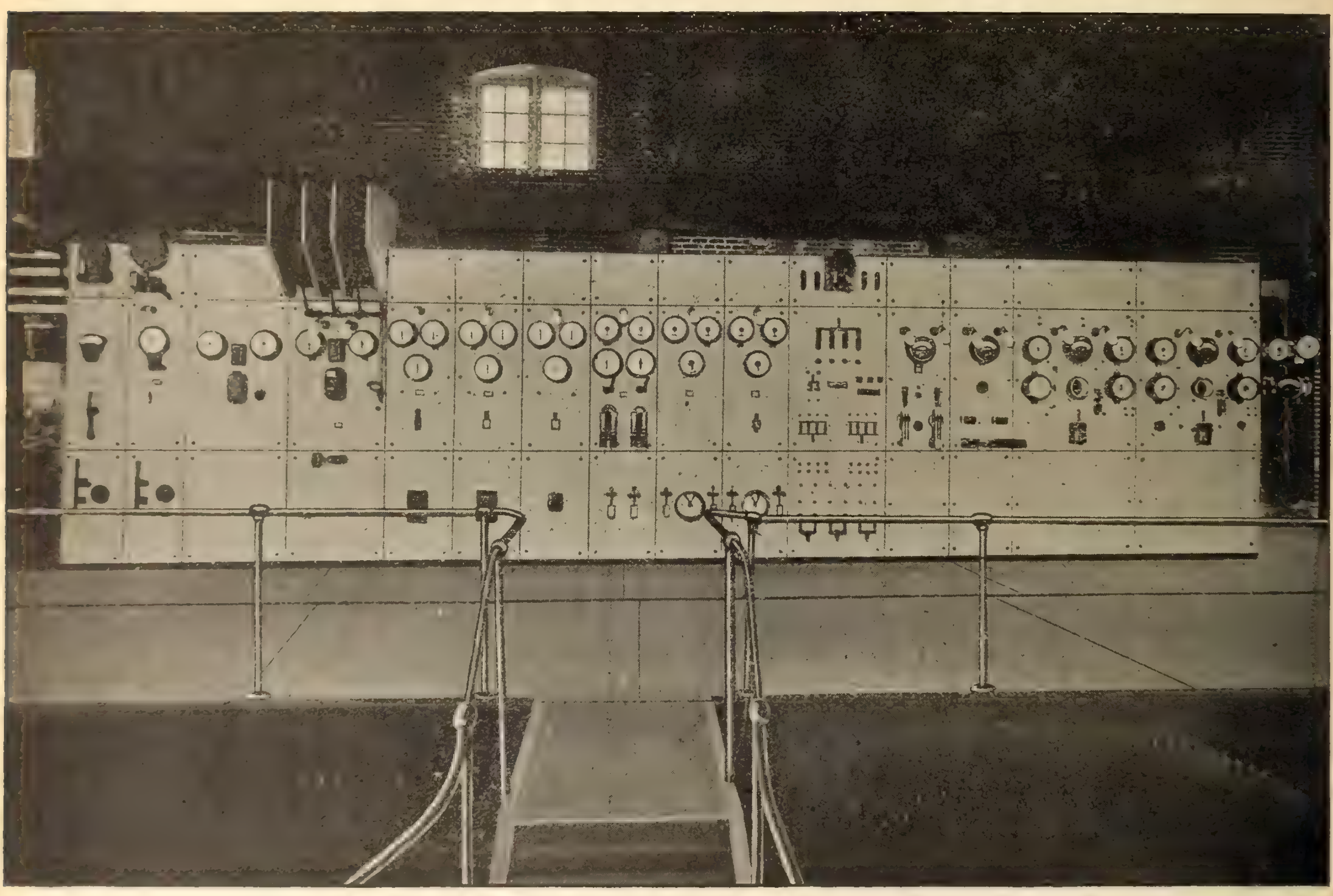
At the terminal station current is taken through lightning arresters and static interrupters to step-down transformers of 1,000 K. W. capacity, similar to the step-up transformers above described. At both the terminal station and generating station the transformers are arranged in a single row, with a track in front.

The transformers are connected in "Tee" at Shawinigan and in "V" at Montreal—the Scott-connection being used at the generating-station to change from two-phase to three-phase. No switching is done on the high-tension side, excepting that knife-switches, thirty inches long, are provided, by which transformers may be connected or disconnected from the line.

Transformers can be put on and taken off the line with these switches, but the amount of power on the line remains the same. The transformers are always excited from the low-tension sides before any of the high-tension switches are thrown. From the low-tension sides of the step-down transformers the current is conducted by means of lead-covered cables laid in conduits through electrically operated oil-switches, to 30-cycle, 3-phase synchronous motors, to which are direct-connected 60-cycle, 2-phase generators, from which current is delivered to the bus-bars of the Montreal Light, Heat & Power Company for general distribution in the city of Montreal. The amount of energy thus being delivered is 6,000 horse-power. During this year the additions to the plant will increase this capacity to 11,000 horse-power. It is expected to eventually use this station for the delivery of not less than 20,000 horse-power.

The minimum low-water flow of the St. Maurice River is sufficient to develop 125,000 horse-power. In the design of the generating station at Shawinigan and the terminal station in Montreal, this fact had to be kept in mind. The size of unit had to be proportioned, so that when the development was complete the number of units would not be excessive. In order to carry out this idea, the smaller units should be installed first, so the unit at Shawinigan was made 5,000 horse-power. Each bank of transformers was made 2,500 horse-power, and each motor-generator at Montreal was made 1,200 horse-power.

This scheme was carried out in the present development of 15,000 horse-power. The point has been reached, however, when larger units can be used with advantage, and the next extension made to the plant will have units of, at least, double the size of the present ones. When the plant is complete, the combination of large and small units will allow all machines to be run at maximum efficiency.



SHAWINIGAN WATER & POWER COMPANY—SWITCHBOARD IN POWER HOUSE

From the main transmission line at Joliette, a town located thirty-five miles from Montreal, current is taken off to a sub-station, where it is stepped down through oil-insulated, natural-cooled transformers to 12,500 volts, and carried by a transmission line across the St. Lawrence river. The submarine cable consists of three No. 6 copper conductors insulated with rubber, containing not less than 30 per cent. pure Para 6/32″ thick. These three conductors are then laid into a cable and surrounded with jute. On the outside of this is 6/32″ of rubber insulator. The sheath of 1/8″ lead is protected by an armor of No. 6 steel wire. Between the lead and the armor is a layer of jute. The cable was tested to double potential for one minute, and has been in successful operation since its installation. Power to the extent of 500 horse-power is now being delivered to the

Sorel Electric Company, which company distributes the power in the city of Sorel for lighting and manufacturing purposes. In a similar manner current is shortly to be delivered from other sub-stations to various towns between Montreal and Shawinigan Falls.

At the first development above described two penstocks were reserved for the Northern Aluminum Company, which company desired to use for its purposes direct current, and perferred to have its plant located in a separate power-house from that of the Shawinigan Water & Power Company. From these two penstocks the Northern Aluminum Company propose to take 10,000 horse-power for the manufacture of aluminum. At present this company is using one of these penstocks and developing over 5,000 horse-power in its power-house. This development of power is by means of three pairs of water-wheels having a capacity of 2,500 horse-power each, each wheel having a 1,000-k.w. generator direct connected on each end of the shaft. These generators produce continuous current at a voltage of 300 volts, which is carried to the smelting-room, about 1,000 feet away from the power-house, over aluminum conductors.

The Northern Aluminum Company has also installed a wire-drawing and cabling plant. The cable for the Montreal and Sorel transmission lines was manufactured in these works. This company also has a plant for the electrical manufacture of carbons for electrolitic purposes.

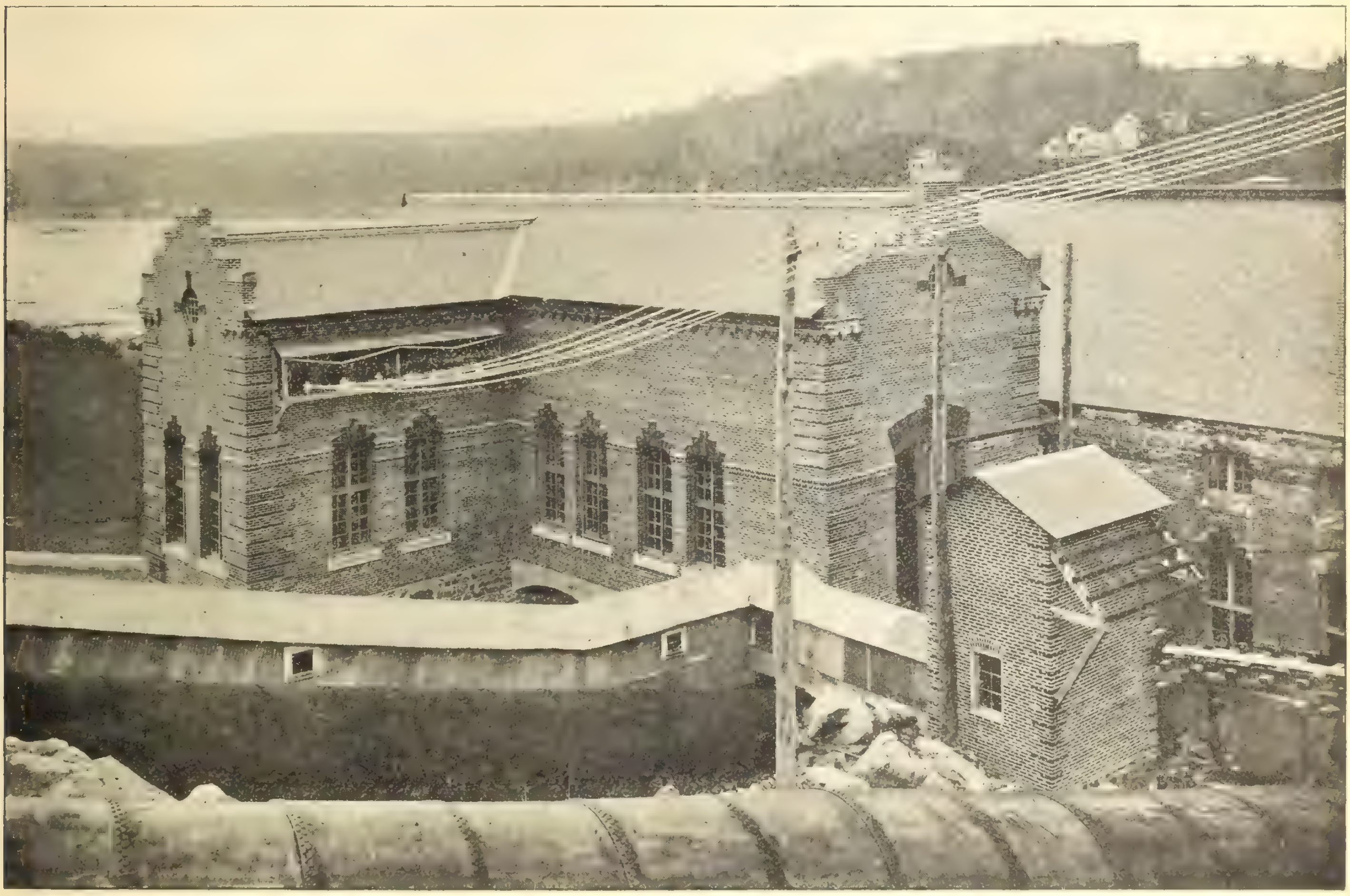
The plant of the Shawinigan Carbide Company, Limited, is located some two miles from the power-house of the Shawinigan Water & Power Company, on the line of the Great Northern Railroad, at which point power is taken in the form of alternating current at 25,000 volts from the transmission line especially constructed for this purpose. This current is then reduced by means of the Carbide Company's transformers to 75 volts.

The electrical equipment of the Carbide Company's plant consists of twelve 300-kilowatt transforms and two 175-kilowatt transformers, the latter for use in connection with the motor equipment which operates all the machinery in the building in addition to supplying current for a 10-ton travelling crane which operates the full length of the furnace room. The twelve larger transformers are for supplying current to the carbide furnaces.

SECOND HYDRAULIC DEVELOPMENT.

For the purpose of furnishing water to factories desiring to install their own water-wheels in their mills, the Shawinigan Water & Power Company made a second development about a half a mile upstream from the canal of the first or main development. Here a concrete forebay has been constructed, from which penstocks are taken to the mills, which discharge their water into the Shawinigan river (at that point at the same level level as the water in the lower lake).

The forebay for the second development was built on the shore of the upper lake, where the depth of water at the lowest stages of the river is not less than twenty feet. The construction was accomplished by first building a crib-work dam two hundred and fifty feet long parallel to and about one hundred feet from the shore. At each end a wing was built connecting the bank. In the main dam, ten openings, each ten feet square, were left near the bottom. This crib-work dam is intended not only as a coffer-dam for construction purposes but as a permanent protection from ice.



Shawinigan Water & Power Company--Transformer House.

It was therefore made of the most solid construction, and about forty feet high, so that the top is above high water. During the construction of the main wall the openings above referred to were closed and the space back of the dam kept dry by pumps. This forebay-wall proper is built of concrete, forty feet high and twenty-five thick at the bottom. The outlet chamber contains the usual steel rack and head-gates for the supplying of two penstocks twelve feet in diameter.

The penstocks are built into the concrete wall, and one of them is extended through the embankment over which the railroad runs, and down to the mill below, a distance of about a thousand feet. The pipe is built of steel ⅜ of an inch thick at the top and ½ inch thick at the bottom. It was carried through the bank in a tunnel which was filled with concrete around the outside of the pipe. The second penstock is reserved for additional mills expected to be built in the vicinity of the present one.

This second water power development is now being used by the Belgo Pulp and Paper Company, owned and operated by Belgium capitalists.

The hydraulic engineers for the work were Messrs. Wallace C. Johnson and T. Pringle & Son, while Mr. Ralph D. Mershon was the electrical engineer.

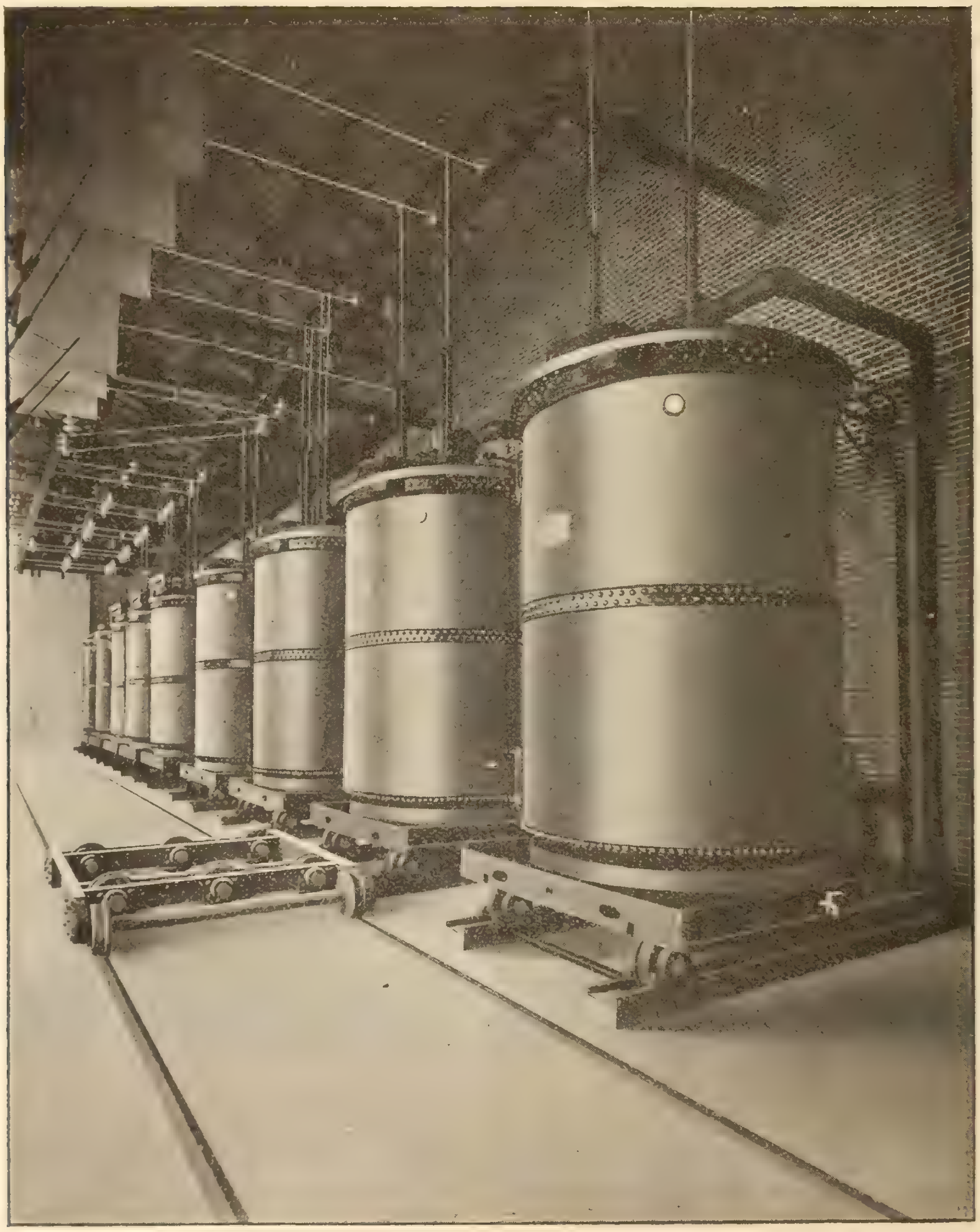
The following manufacturers supplied the machinery and equipment :

Hydraulic Equipment—I. P. Morris Company, Philadelphia ; Escher, Wyss & Co., Zurich, Switzerland ; James Leffel & Co., Springfield, Ohio ; Lombard Governor Co., Boston, Mass ; S. Morgan Smith Co., York, Pa.

Electrical Equipment—Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.; Canadian General Electric Co., Toronto, Ont.; Bullock Electric Mfg. Co., Cincinnati, O.; Dick, Kerr & Co., London, Eng.; General Incandescent Arc Light Co., New York.

Steel Work and Auxiliary Apparatus—John McDougall Caledonian Iron Works, Montreal ; Dominion Bridge Co., Montreal ; Phœnix Bridge & Iron Works, Montreal ; Struthers, Wells Co., Warren, Pa.; Pontbriand & Co., Sorel, Que.

Line Construction—Cable and Wire : Northern Aluminum Co., Shawinigan Falls ; National Conduit & Cable Co., New York ; Wire and Cable Co., Montreal. Insulators : R. Thomas & Sons Co., East Liverpool, O. Sub-marine Cable : American Steel and Wire Co., Worcester, Mass.



Shawinigan Water & Power Company—Transformers Stepping Up Current from 2,200 Volts to 50,000 Volts.

WINNIPEG AMALGAMATION.

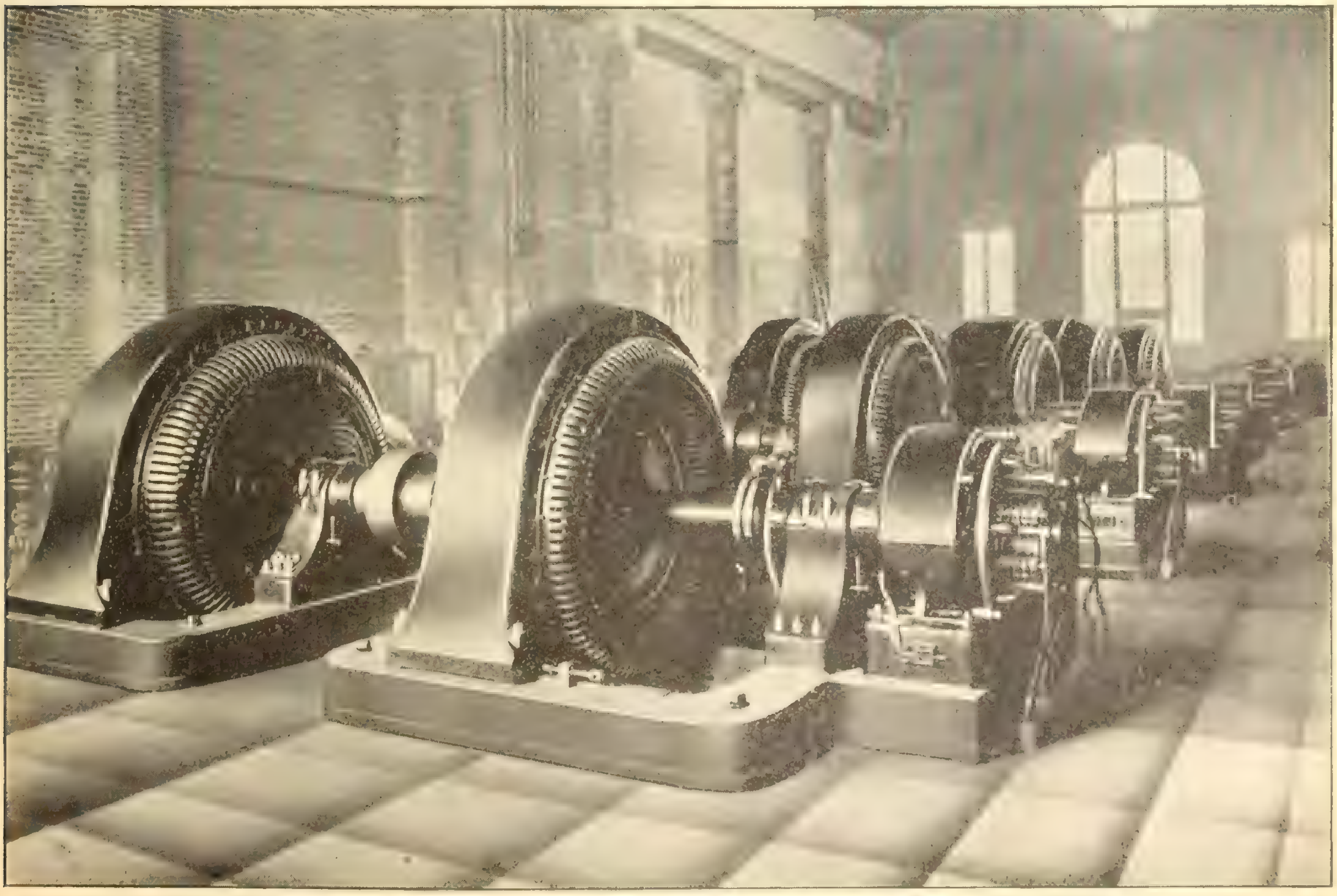
The amalgamation of the Winnipeg Street Railway Company and the Winnipeg General Power Company has been consummated, and the new organization will be known as the Winnipeg Electric Railway Company. The capital stock is $4,000,000. Mr. William Mackenzie is president of the new corporation, Mr. William Whyte vice-president, and Mr. F. M. Morse secretary-treasurer. Mr. Wilford Phillips has been appointed general manager of the entire combined properties. The new company undoubtedly constitutes the greatest industrial institution in the west. They will operate the street railway systems of Winnipeg and St. Boniface, the commercial electric lighting and power business and the gas plant.

Shawinigan Water & Power Company—Transmission Line over Ottawa River at Bout de l'Isle on Chateauguay and Northern Railroad Bridge.

THE BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY.

The report of the British Columbia Electric Railway Company for the twelve months ended June 30 last shows an increase in gross receipts of $138,445, and in net earnings of $60,649. The number of lights in use at June 30, 1904, was 112,911, an increase of 18,182. The number of passengers carried during the year was 8,869,486, an increase of 1,505,197. The construction of the Vancouver power installation is stated to be proceeding very satisfactorily. The concrete dam at Trout Lake, the power house and the sub-stations have all been completed and three pipe lines are in place. The engineers estimate that the work will be completed about May, 1905.

The Town Council of Meaford, Ont., have decided to offer Moore & Sons $8,600 for their electric light plant.



Shawinigan Water & Power Company—Motor Generators in Terminal Station, Changing Frequency from 30 Cycle to 60 Cycle.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope o this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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A Merry Christmas and Prosperous New Year.

A Word of Explanation. At the solicitation of a number of subscribers, it has been decided to substitute the Questions and Answers Department, which was formerly a feature of this journal, for the Technical School which has appeared in recent issues. Both departments being somewhat similar in character, the one for which there appears to be the greater demand has been reinstated. Since this action has been taken to meet the wishes of subscribers, we trust they will assist us as far as possible to make the Questions and Answers Department a success by submitting questions as well as comment upon answers which may be given.

Ground Connection The central station man spends many sleepless nights endeavoring to devise schemes to keep his lines free from grounds, and many other nights in the vain attempt to provide permanent grounds for his transformer, secondaries and lightning arresters. This paradox would be amusing were it not for the very serious phase it frequently assumes. Line troubles are usually overhead and their remedy is merely a matter of continual attention, but the ground wire question is one presenting no such easy solution. In large cities where water pipes, gas pipes and street railway tracks are laid, the obtaining of permanent and frequent grounds is not difficult, but in locations having none of these things, the matter is entirely different. The copper plate set deep in the earth and surrounded by powdered coke is undoubtedly the most satisfactory thing yet devised, but where the earth dries out, the connecting wire might just as well be dead-ended on a high tension insulator. In a plant we know of, the lightning arrester connection is made to the earth in the manner just mentioned, and the earth being very dry at times, a small pipe is run down to the coke. On the approach of a storm, a pail of water is poured down this pipe, and the arresters so far have never failed. This appears to be a good suggestion and is applicable in many ways. Where it is the policy to ground all secondaries, why not run on the poles a "ground feeder," connect all the middle points of the secondaries to it, and attach it to a few well distributed, permanent grounds, which can be kept good, with the water pipe scheme just mentioned, by giving them a pail of water at predetermined intervals? The time is rapidly approaching when the law will require that all secondaries be grounded, and the sooner the question of a good ground is solved, the easier will rest the plant operator.

The Lightning Rod. In the early days, when the study of the action of lightning led to the attribution to it of certain fairly well defined peculiarities, the country was scourged by silver-tongued gentlemen, who intimated in a sauve and convincing manner that they were on excellent terms with Jupiter, and could supply, upon payment of a sum, small in comparison with the value given, a device absolutely guaranteed to appease the wrath of the god, and to act as a protecting shield for all the property, real or personal, of the owner of said device. The payment of the small sum was the chief necessity for the proper working of the contrivance, and the whole proposition being placed before the buyer in a favorable light, it was not many years before the entire country bristled with the little prongs of lightning rods. Now, the lightning rod, when properly installed, is an excellent thing, but the wholesale distribution of the article, and the speedy disappearance of the peripatetic vendor, after having tacked up a length or two of copper wire and received the small sum previously mentioned, produced in the mind of the confiding rustic a faint suspicion which gradually but surely grew to such proportions that the reappearance of the sauve gentlemen would be attended with considerable excitement, not to mention the possibility of his departing again, carrying with him several little pellets of lead, known commonly as buckshot. It is not hard to understand how the lightning rod fell from the popular position accorded it upon introduction, nor, being really a good thing, is it difficult to definitely point out the real cause of this fall. Those of us who have had to do with the installing of lightning arresters appreciate the difficulty of providing a good and permanent ground where water mains are not laid, and know of the required size of ground wires, and the necessity of straightway running. If our modern equipments sometimes fail, is it any wonder that a ten gauge copper wire, full of kinks and sharp bends, stapled along the roof and down the wall, and buried half a foot in the earth, failed to protect the building on which it was installed under the name "lightning rod"? And even if this poor makeshift should act upon occasions, there was no evidence of its having done so, while on the other hand, if it failed, the owner of the house lost what little confidence he ever had. Now, as we said before, the lightning rod is a very good thing, but it must be put up with the greatest of care, and the ground connection kept good. When we consider that statistics for a certain year in the United States show that about four and one-half per cent. of the total fires during that period were caused by lightning, and that the value of the property thus destroyed exceeded $4,000,000, it becomes apparent that the good lightning rod is a thing very well worth while, as its cost can be but a fraction of one per cent. of the value protected. Of course, this protection is not always needed, for in some localities lightning storms are very rare and are never severe. The subject has been considered of sufficient importance, however, to warrant a complete investigation on the part of the National Fire Protective Association. A preliminary report is the only document so far at hand, but when the full findings are presented to the public, the advice, if heeded, should result in a lowering of the number of fires due to lightning. The flat-roofed building, in comparison with those having gabled roofs, seems to be immune from discharges from the clouds, while church steeples, and tall smokestacks, appear to be desirable channels from a lightning point of view. Various areas require different forms of protection, and various metals and materials of building construction also require different styles of equipment. An important suggestion is that the conductor should not be insulated at any point from the building to be protected, but should be fastened firmly thereto by material of the same nature as the conductor. Whether this is generally understood is doubtful, for it is a fact that lightning rods are often fastened to the roofs of buildings, and then, on their course to the ground, have been passed through insulating spools. The organization which has undertaken the work of getting at the facts in connection with this subject is very sincere in its desire to lessen the effects of lightning strokes, and its conclusions are certainly worthy of consideration, not only by the house owner, but by the constructing engineer as well.

So-called Electric Fires.

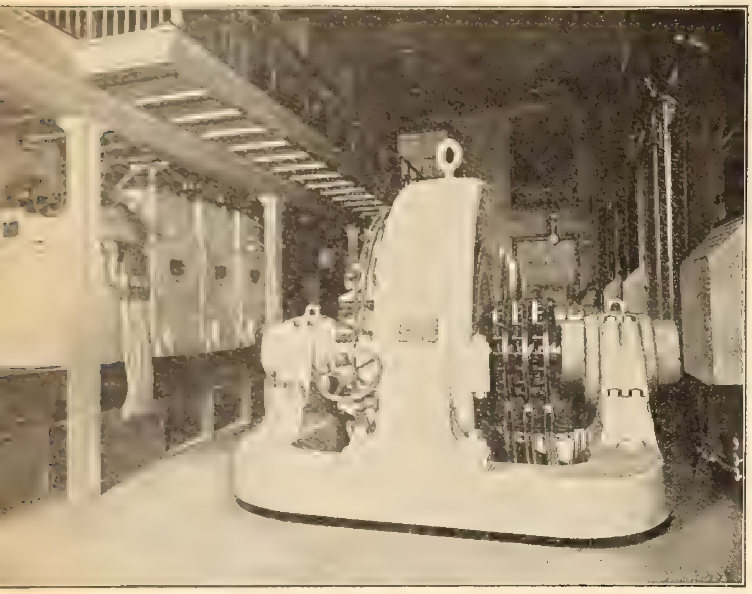
"Either from new electric wires at the foot of the elevator shaft in Bullman Bros., or of an entirely unknown origin" is the report handed us by high insurance authorities, on the cause of the disastrous conflagration which visited Winnipeg on the night of October the eleventh. It is not our intention to throw light on the mystery which surrounds fires of this nature, but to point out and denounce, completely and emphatically, the growing tendency on the part of the public and insurance men to cast the onus of every fire, the cause of which is doubtful, upon the already over-burdened shoulders of electric wiring. Never before has the absolute absurdity of this practice been brought out so clearly as by the above quotation, for the very wording of it is self-condemnatory. It is indicated without question that the origin of the fire is unknown, but nevertheless, a suggestion is made as to a possible cause, and the matter is carried so far as to hint at the point of defective insulation. We do not for one moment imply that in many of our fires a certain percentage can properly be charged to wiring, but the point we wish to make is that the true proportion is anywhere from one quarter to one third of the number indicated by popular opinion. Wherever there occurs a fire of questionable origin, the first inquiry invariably is in regard to whether or not the building contains electric light or power wiring, and an affirmative answer seems to clear up at once all mystery surrounding the affair. The whole tendency has been in this direction, and having received little or no opposition, the "defective wiring" cry has become an unjust and trouble-producing habit. When an electric wire is properly installed, it should be practically everlasting, and barring mechanical interference, should be as good at the end of ten or twenty years as when it was put in place. The growing favor of conduit systems indicates that modern engineering prescribes that all concealed wiring shall be as easily removed as drawn in, and if a particular circuit shows too low a resistance between wires, or between either side and the ground, the removal and subsequent examination shall be made as simple a matter as possible, and one of negligible time and expense. When a completed house or building is to be equipped with electric light, the æsthetic public demands that the wires shall be hidden, and not being willing to stand the expense of a proper installation of conduits, is actually responsible for those fires which really occur from defective wiring. The underwriters realized this long ago, and steps were taken to guard against the anticipated trouble, but never was there rule or regulation made which could not be avoided or got around in some manner. With competition between the wiremen as keen as it is, any method of reducing the cost of the work has been eagerly sought for, and, we are sorry to say, when such means has been found, the direct result has been a lowering of the standards set up by the controlling body. We have known of cases where concealed wiring was specified, and where the conductors were fished for twenty or thirty feet between the ceiling and the floor. In the instance in mind, the wires caught on some projection, and the job was completed by two men pulling them through by sheer strength. What about the condition of the insulation of those wires after they were installed? One felt reasonably sure that serious damage had been done, but going on the supposition that what cannot be seen is all right, they were considered o.k. There is just one solution to this problem, and in it lies the stamping out of the absurd theory of the "electric fire," and that is, first, avoid cheap work, and second, know the man who does the work. Spare no pains to make the installation as permanent as the building itself, and the money spent in this way will return a hundred-fold.

POLYPHASE INDUCTION REGULATORS.*

By G. H. Garcelon.

In the application of alternating currents it is often necessary to regulate the voltage of parts of the transmission circuit. This regulation obviously must be accomplished by some means entirely removed from the generator. The induction regulator is designed for such a purpose.

The most familiar manner of attaining this remote regulation, as it may be termed, is by the use of a transformer with its primary connected across the line and its secondary, having a number of taps, in series with the line. A device is employed by which more or less of the secondary turns may be cut in, to vary the voltage supplied to the load. Here complications necessarily arise because the circuit must not be broken when changing from one tap to another and the coils between two adjacent taps must not be short-circuited in the process. Here also the regulation is not continuous but in steps of a magnitude which is dependent upon the number of taps from the secondary. Therefore for fine regulation by this method a great number of taps from the secondary is necessary.



1000 K.W. Six-Phase Rotary Converter and Induction Regulator, in Use by the New York Edision Company.

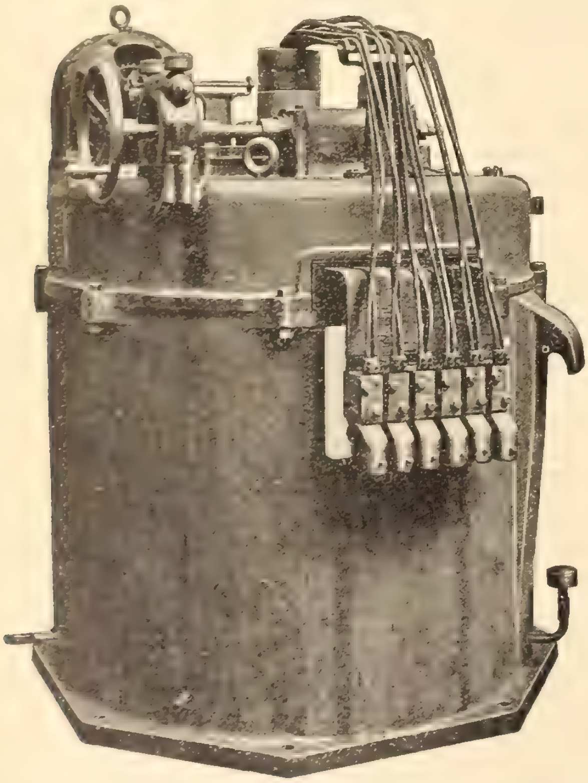


Fig. 1.—A Six-Phase Induction Regulator Which in General Appearance is Similar to the Three-Phase Type.

An induction regulator is essentially a transformer in which the relative position of the primary and secondary may be varied. Like the regulating transformer, it is connected with the primary across the line and the secondary in series with the line. The regulation of the voltage supplied to the load is effected by moving the primary core which changes the relative position of the primary and secondary coils. This change does not alter the magnitude of the voltage induced in the secondary, but does alter the phase relation of primary and secondary voltages, and therefore changes the value of the load voltage, which is the resultant of the primary and secondary voltages.

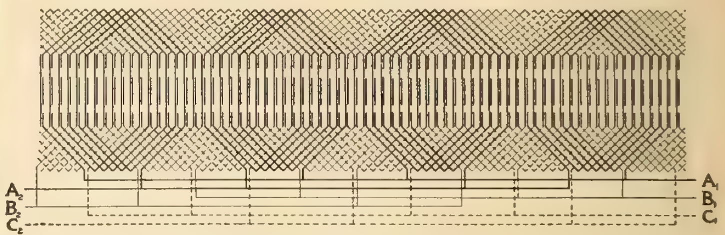


Fig. 2.—Winding Diagram of the Secondary of a Three-Phase, Four-Pole Induction Regulator.

Polyphase induction regulators are most commonly used for the voltage control of rotary converters carrying a lighting load, which requires a fine though not necessarily an automatic regulation.

Fig. 1 shows a complete six-phase induction regulator operated by means of a small induction motor and worm-gear.

The primary core is built up of laminated steel punchings carried on a shaft. The secondary core, also composed of steel punchings, surrounds the primary and is held in a casting which serves as the support of the regulator. Both cores are slotted parallel to the axis of the shaft to receive the coils.

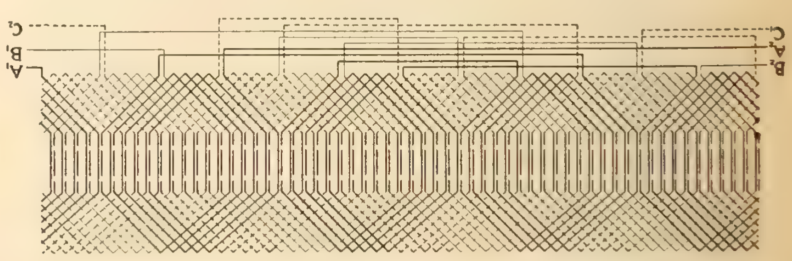


Fig. 3.—Winding Diagram of the Primary of a Three-Phase, Four-Pole Induction Regulator.

The secondary is stationary and the primary is arranged with vertical bearings that it may be rotated a portion of a revolution correspoding to one pole. The windings are similar to those of an induction motor having a wound secondary with the exception that the secondary phases are not connected together. Figs. 2 and 3 show the developed windings of a three-phase four-pole induction regulator. A vertical full line represents one side of a coil which lies in the top of a slot. The adjacent broken line represents one side of another coil which lies in the bottom of the same slot. The secondary winding has a parallel connection because the total load current passes through it. The number of secondary turns in series is determined by the range of regulation desired. Fig. 4 shows the station wiring diagram for a three-phase regulator and rotary converter. The upper triangle represents the three phases of the primary of the regulator. The heavy lines parallel to the sides of this triangle represent the phases of the regular secondary. S S S represent electrically operated switches. The lower triangle shows the three phases of the rotary converter.

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*From the Electrical Club Journal, Pittsburg. Published by permission.

The current in the primary coils sets up a rotating magnetic field. The load current passing through the secondary coils also sets up a rotating field. The primary is so connected that these two fields rotate in the same direction. The voltage induced in the secondary is due to the resultant of these two fields, and its phase position with respect to the line voltage is determined by the phase position of this resultant. The relative position of primary and secondary coils has no influence on the magnitude of the resultant field and therefore the numerical value of the induced secondary voltage is the same at all positions of the primary. Moving the primary core does change the phase position of the resultant field and therefore of the secondary voltage. With no current in the secondary it is easy to see that the resultant magnetic field is a constant because then the secondary field is zero and the primary furnishes the only active field. In this case any change in the relative position of the primary and secondary coils will obviously alter the phase relation between the primary voltage and the induced secondary voltage.

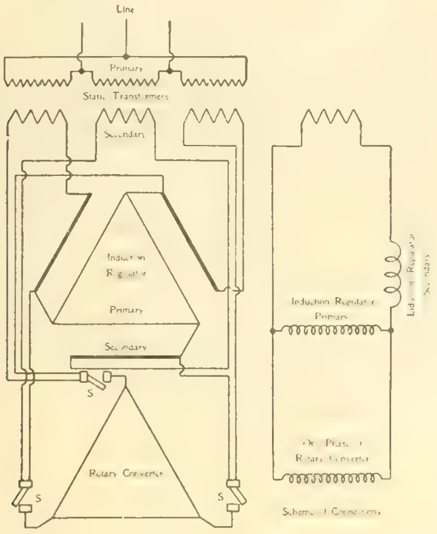


Fig. 4.—Station Wiring Diagram for a Three-Phase Induction Regulator.

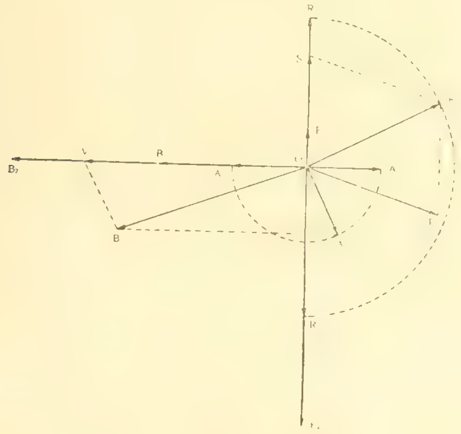


Fig. 5.

Now consider the case where there is a current in the secondary. Since both fields rotate at the same speed and in the same direction they may be treated as two stationary fields when considering their phase difference for any given position of the primary coils. Consider the load current a constant and therefore the secondary field constant. In Fig. 5 let OS represent the field set up by the secondary current. The primary field, OP, is in phase with OS and their resultant is OR, the line voltage is OV, the induced secondary voltage is OA, and the resultant or load voltage is OB. This is the position where similar primary and secondary coils lie underneath each other, and the load voltage is a minimum. When the primary is turned the position of its field is obviously changed relative to the secondary field. OP_1 shows the primary field after the primary has been turned through an angle equal to POP_1. In this position the secondary field does not have as much effect on the primary coils, and the current in the primary increases, thereby increasing the primary field and keeping the resultant OR_1 of the same magnitude as before. This action is quite similar to the regulation of a shunt transformer. The induced secondary voltage will be of the same magnitude as before, but being always 90 degrees behind the resultant field it will have the phase relation to the line voltage OV shown by OA_1. In this position OB_1 is the load voltage. When the primary has been turned 180 degrees, its field is opposite the secondary field as shown by OP_2. Here it is more clearly seen that the primary current and field will be increased in magni-

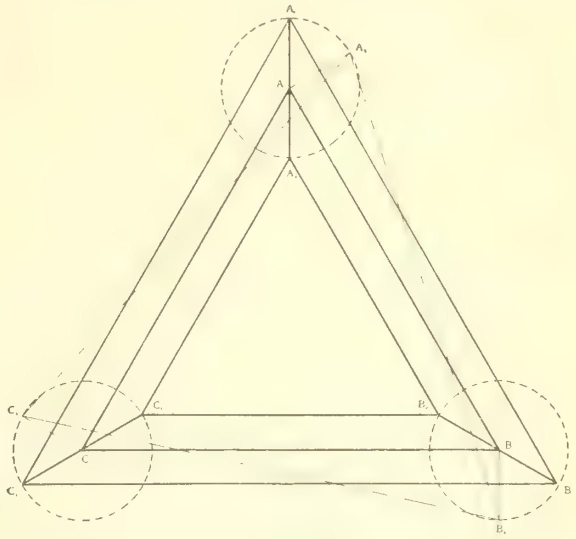


Fig. 6.—Effect on the Load Voltage of the Varying Phase Relation Between the Primary and the Secondary.

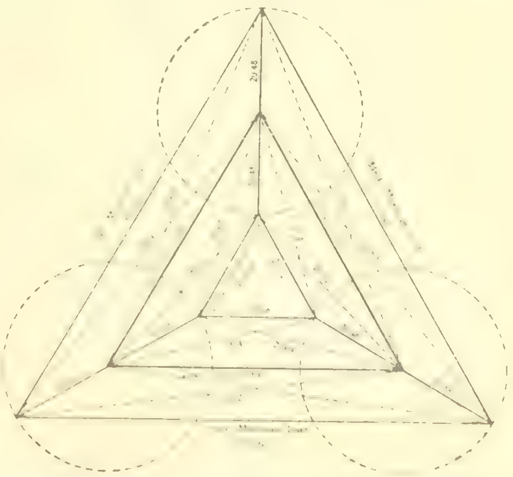


Fig. 7.—Test Readings Taken on a 50-K.W. Three-Phase Induction Regulator, to Check the Maximum and the Minimum Points.

tude because the primary field is directly opposed by the secondary. The induced secondary voltage is here in phase with the line voltage giving a load voltage OB$_2$ which is the maximum. Thus it is seen that a movement of the primary through 180 electrical degrees or one pole, changes the load voltage from a minimum to a maximum. If the secondary current does not remain constant the secondary field will change in magnitude. The primary field will again change to keep the resultant a constant. Of course the resultant field will vary slightly according to the percentage regulation. However, induction regulators are designed to give a very close regulation.

Fig. 6 shows the line voltage, secondary voltage and resultant voltage for different positions of the regulator. The triangle ABC represents the line voltages. The secondary voltages are represented by the radii of the circles. With the secondary voltages in the positions AA$_1$, BB$_1$, and CC$_1$, the maximum voltage is given to the load as shown by the triangle A$_1$ B$_1$ C$_1$. When the primary has been turned 180 electrical degrees, the triangle A$_2$ B$_2$ C$_2$ is the resultant, being the minimum. A$_3$ B$_3$ C$_3$ shows the resultant voltage for an intermediate position of the primary.

Fig. 7 shows some test readings which were taken on a 50-kw regulator to check the maximum and minimum voltage points.

The operation of polyphase regulators in parallel, as is done with shunt transformers, is impossible except in such cases where the rotating parts are rigidly coupled. This is obvious from the fact that if operated in parallel they must have the same phase relations at all times, otherwise local currents will result.

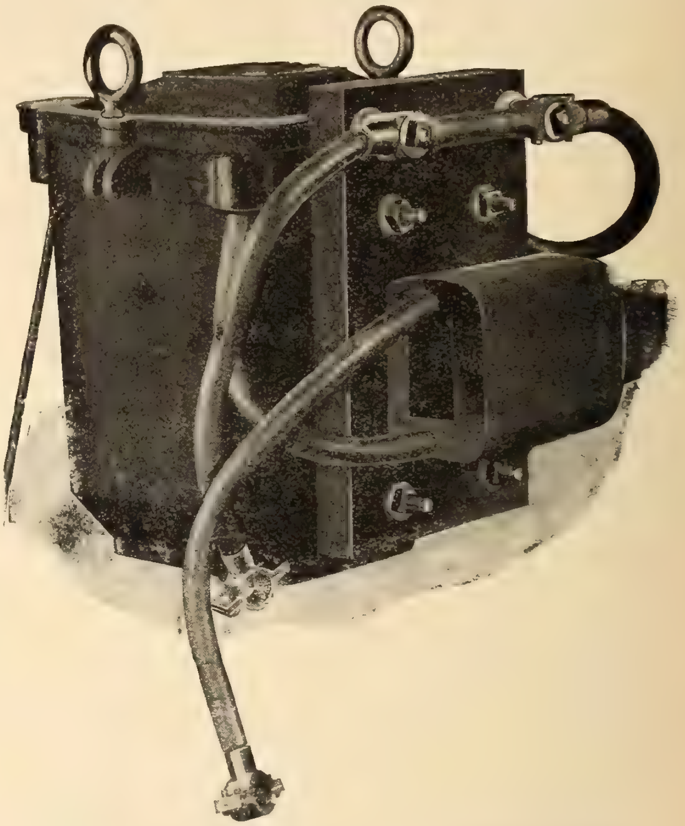
THAWING PIPES ELECTRICALLY.

Thawing frozen water pipes by electricity promises to pay handsome returns. Last winter a few companies tried it in a more or less experimental way, and reports have been made showing the profit in the work. The revenue derived was considerable and sufficient to show the necessity of cultivating the business. There is no question as to the practicability of the method, and consequently the Pittsburgh Transformer Company have made arrangements to furnish complete apparatus for the purpose.

Pittsburgh Transformer Company's Pipe Thawing Outfit. Front View, Showing Primary Leads.

The outfit consists of a transformer adapted to operate on any circuit of approximately 1,100 or 2,200 volts and 60 or 133 cycles. The transformer will deliver a current of 300 amperes continuously, or currents of about 600 amperes for periods of half an hour.

On the back of the transformer are mounted a heat indicator and a choke coil. The heat indicator consists of a section of lead pipe, connected in series with the transformer, and the temperature which this assumes is a guide as to the heating of the pipe under treatment. The choke coil consists of a few turns of heavy copper bar, with a moveable laminated iron core.



Pittsburgh Transformer Company's Pipe Thawing Outfit. Rear View, Showing Low Voltage Cables and Choking Coil.

When this plunger is pushed entirely into the coil, the transformer secondary may be short circuited, but no more than normal current will flow.

DIRECTIONS FOR USE.

The object is to send current through the frozen section of pipe. One secondary lead should be connected to the pipe inside of the house and the other lead connected to a nearby hydrant outdoors, or to a pipe inside of a neighboring house. The following instructions should be followed :

1. Connect transformer to the primary line in the usual way, altering the connections on the porcelain terminal block, if necessary, to adapt it to your line voltage, as shown on tags attached to transformer.

2. Use any standard fuse blocks to protect transformer. Fuse these with a 20 ampere fuse for 1,100 volt circuits or with a 10 ampere fuse for 2,200 volts. Don't plug in until you are ready to operate.

3. Use about a No. O wire or cable for the secondary connections. Put in a switch heavy enough to handle about 400 amperes. A single pole switch will do.

4. Look over your connections carefully. Push plunger clear into the choke coil, plug in the fuse blocks, and close secondary switch.

5. Keep your hand on the heat indicator and pull out plunger little by little until the indicator is hot enough. Water will usually begin to flow slowly in five or ten minutes ; let it run so as to wash away the remaining ice, and disconnect the outfit.

Don't leave the transformer in circuit longer than necessary.

Pull the primary fuse plugs when pipe is thawed.

Don't close the secondary switch unless plunger is pushed into the choke coil as far as it will go.

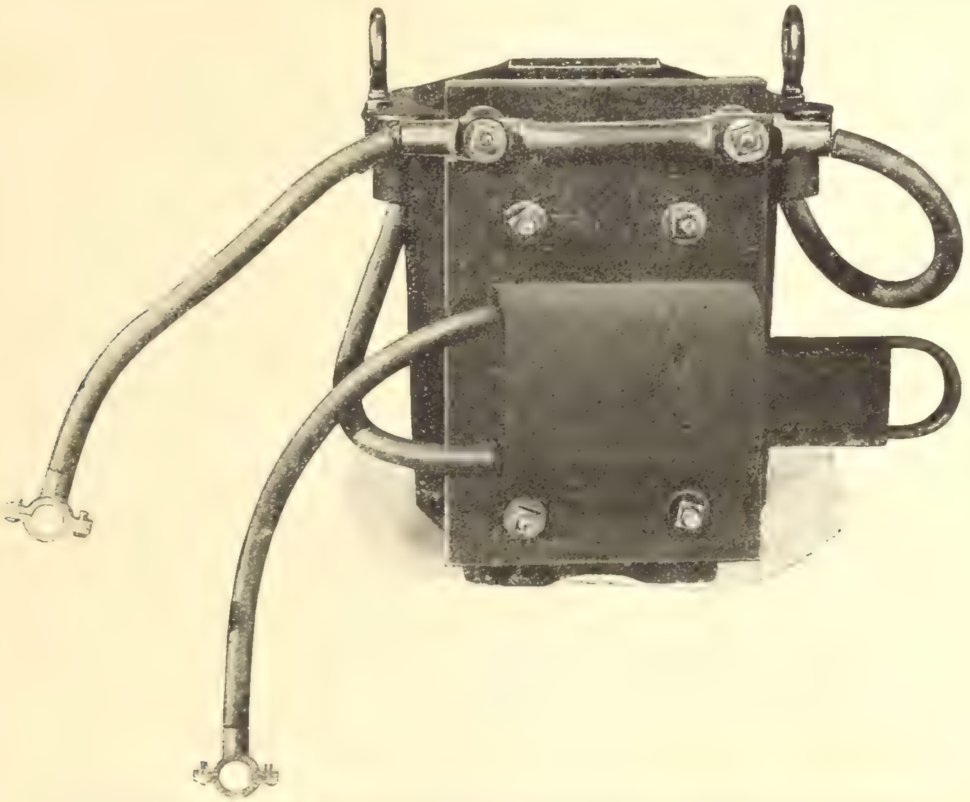
Don't use the transformer without oil.

Don't make your connections carelessly or you will burn the pipes or faucets. Be sure the primary line is not grounded on the transformer or its connections.

It is understood that the Pittsburgh Transformer Company's thawer costs only $100 and weighs but 235 pounds, advantages which are worthy of consideration.

THE SINGLE PHASE RAILWAY MOTOR.

At the eleventh regular meeting of the Toronto Branch of the A.I.E.E., held Friday evening, November 18th, the subject under discussion was single phase railway motors, which was introduced by Prof. T.R. Rosebrugh, of the School of Practical Science. Prof. Rosebrugh reviewed briefly the various papers on the subject which had appeared in the transactions of the Institute since the first application of this type of motor for railway purposes a few years ago. As late as July, 1902, it was generally considered that the induction motor was not adapted for railway work. In the following year the Baltimore, Ohio, and Annapolis Railway was equipped with alternating current motors of the series type, and the successful operation of the road greatly influenced sentiment in favor of this system. There was also an experimental single phase road in operation in Schenectady, these two roads bieng the only examples on this side of the water.



Pittsburgh Transformer Company's Pipe Thawing Outfit—Rear View, Showing Plunger Partly Drawn Out of Choke Coil.

The question of frequency, Prof. Rosebrugh said, was a very inportant factor, and whereas high frequencies were first used, the present tendency was to adopt a frequency of 25 cycles. This he considered necessary in order to get over the trouble of sparking, and he thought it quite possible that a frequency as low as 15 would be adopted in the near future for railway work.

The discussion which followed showed that, while the utility and usefulness of alternating current were generallly admitted, the extent to which it would replace direct current in railway service was by no means certain. Mr. Fisk was of the opinion that for interurban roads alternating current might possess some advantages, but for city work he believed the direct current motor would hold the field. There were several points yet to be worked out in the a. c. apparatus and the carrying of heavy transformers on the cars was a drawback.

Mr. R.G. Black thought the carrying of transformers was not as objectionable as the necessity of having rotary converter sub-stations every ten or twelve miles, with expensive attendants, as in the case of the direct current system.

Mr. K. L. Aitken did not think that the field of the single phase motor would be limited to interurban or long distance roads. One of the advantages which would commend it for city railway service was its freedom from electrolytic effect upon water pipes.

Mr. Black spoke of the great possibilities in the electric railway field. The manufacturing companies were extending their plants largely in anticipation of the demand for railway equipment. Electric traction had many advantages over steam traction, and just as soon as one trunk line had been converted to electricity and successfully operated, other roads would follow. It was therefore necessary to design apparatus and perfect details of operation so as to obtain the best results.

Mr. R. J. Parke thought that the most promising field for electric roads was as feeders to the trunk lines where a frequent service was essential.

Mr. Aitken said the cost of installation was a factor in favor of the alternating current, comparison showing an average saving of ten to fifteen per cent. over the direct current system.

Mr. W. A. Bucke said that a combination of the direct current and alternating current system was intended to be used by the Southwestern Traction Company, of London, Ont., it being an extension of the Ganz system as adopted in Europe.

After the members had expressed their views a vote of thanks was tendered to Prof. Rosebrugh for his introduction of the subject. The members were then afforded the pleasure of examining some interesting specimens of radium which Mr. R. J. Parke had with him.

At the regular meeting of the Toronto branch on Fridey evening, December 9th, there was an interesting discussion on "Construction Work," which was introduced by Mr. C. H. Wright.

QUESTIONS AND ANSWERS

GENERAL RULES TO BE OBSERVED BY CORRESPONDENTS:

1. All inquiries will be answered in the order received, unless special circumstances warrant other action.

Questions to be answered in any specified issue should be in our hands by the close of the month preceding publication.

3. Questions should be confined to subjects of general interest. Those pertaining to the relative value of different makes of apparatus, or which for intelligent treatment should be placed in the hands of a consulting engineer, cannot be considered in this department.

4. To avoid trouble and unnecessary delay, correspondents should state their questions clearly, so that there can be no possible doubt as to the information required.

QUESTON NO. 1: Will you please give me a good formula for a dry cell?

ANSWER: The dry cell is dry only in the sense that it does not spill. The chemical action, and the chemicals used, do not differ materially from the ordinary Leclanche battery. Those in practical use are nearly all some form of sal-ammoniac cell, with the zinc made into the form of a containing jar. The top is sealed over to prevent evaporation, and the electrolyte is all taken up by an absorbent, so that there is no liquid to spill even before the top is sealed over. The carbon is usually in the form of a slab. In constructing a dry cell, a plunger somewhat larger than the carbon element is placed in the middle of the zinc jar, and a solution composed of 1 part sal-ammoniac, 1 part chloride of zinc, 3 parts plaster of paris, 1 part flour and 2 parts water, is poured in around it. This rapidly becomes stiff, and then the plunger is withdrawn and the carbon inserted in its place. Around the carbon is placed a mixture consisting of 1 part sal-ammoniac, 1 part chloride of zinc, 1 part peroxide of manganese, 1 part granulated carbon, 3 parts plaster of paris, 1 part flour and 2 parts water. After this is in position the top is sealed over with bitumen or other suitable compound, and the cell is ready for use. We would advise you strongly not to recharge dry cells yourself, unless it is done purely for experience. Being turned out in vast quantities, the price of a new cell is so low that recharging can hardly be carried out on a commercial basis. This is due, not so much to the cost of the chemicals, but to the amount of labor required to dig out the old mixtures. An old dry cell can be charged, if a source of direct current be obtainable, and while the second life will not be as long as the original, still the cell will be found fairly satisfactory. The method of charging is the same as applies to a single cell of storage battery. The positive of the dry cell should be connected to the positive source of current, and one or more incandescent lamps wired up in series with it, so as to give a potential of approximately two volts across the cell terminals. The length of time required to charge varies with the condition of the battery. No fixed rules can be laid down in this connection, experience being the only reliable guide.

QUES. NO. 2: What is the easiest way to make a rough test to see whether the resistance between any wiring and the earth complies with the Underwriters' rules? We have a 125 volt direct current plant, but no portable instruments except a Weston voltmeter.

ANS.: The Weston meter referred to will be quite sufficient to make an approximate reading of the resistance. On the inside of the meter box cover you will find the resistance of the instrument given in ohms. Connect one side of your 125 volt line to the circuit to be tested, and one terminal of the meter to the other side of the line. From the other meter binding post, run a piece of wire long enough to reach either the switch or the ground. Then you are ready. By means of the loose wire connect the instrument across the line. For the sake of illustration let us suppose that it indicates 110 volts, and let us also assume that the resistance of the meter is 10,000 ohms. Now quickly transfer the end of the loose wire to the ground connection, and if the meter still reads 110 volts, this shows that no additional resistance has been interposed in the meter circuit, and that there is a dead ground on the wiring. If the meter show, say, 55 volts, it indicates that the resistance in its circuit is just double the resistance of the meter itself, therefore giving 10,000 ohms as the resistance between the wiring and the ground. This same method applies to any other reading of the instrument; for instance, if it read 27½, the resistance of the insulation is 40,000—10,000 = 30,000 ohms; or if it read 82½, then the resistance is 13,333—10,000 = 3,333 ohms. This is worked out by the following equation: d : V-d :: R : r, when V is the line voltage; d the deflection of the instrument when connected to the ground; R the resistance of the meter; and r the resistance between the circuit and the ground.

QUES. NO. 3: What is the principle of the Tangent Galvanometer? What is it used for?

ANS.: The Tangent Galvanometer is practically confined to the laboratory for the measurement of direct current. It is very valuable for scientific investigations, being an absolute instrument. Great care must be used in its handling, however, or errors will occur in its readings. It consists of one turn, or a few turns of heavy wire, in the centre of which is pivoted a delicate compass needle. It is necessary that the needle be small in comparison with the diameter of the coil, for in this feature rests the accuracy of the instrument. The galvanometer is set up level, with the coil in the magnetic meridian, that is to say, with the needle pointing to the zero of its scale, which is located in the plane of the coil. The magnetism of the earth holds the needle in this position, and when a current is passed through the coil, the field thus set up at right angles to the magnetic meridian tends to deflect the needle from its original position. The stronger this field the greater will be the deflection. The reason that the coil of wire is made large is that the field set up is very uniform at the centre, the lines of force at this part being practically parallel, and at right angles to the plane of the coil, while at other points inside the circle the field is neither uniform nor normal in direction. The needle being small, its poles are never far from the centre of the coil, nor do they project into that space where the force is irregular. The strength of a current flowing through a tangent galvanometer is obtained by multiplying the tangent of its angle of deflection by the horizontal component of the earth's magnetism, and by a constant factor derived from the dimensions of the instrument. This applies when used as an absolute meter, but the galvanometer can be used as a non-absolute instrument by comparing the deflection, caused by the current to be measured, with that of a known current. The ratio between the tangent of the deflection of the tested current, and the tangent of the angle of the known current, will be the ratio between the two strengths. For the purpose of simplifying the readings, the needle scale is often marked direct in amperes, the values having been obtained by trial with some standard.

ENGINEERING and MECHANICS

THE COMBUSTION OF COAL IN BOILER FURNACES.*

By G. D. Bly,
Chief Engineer W. A. Murray Company, Toronto.

The subject of smoke prevention admits of wider treatment than is usually accorded it. The whole question of the combustion of coal is one of national importance, and is inevitably linked with that of smoke prevention. Not that it must be supposed for one minute that a smokeless fire is necessarily an economical fire; in many cases a fire may be perfectly smokeless and yet may be the cause of a very great waste of heat. Still, on the other hand, a fire may easily be smokeless and efficient; in fact, some of the causes of smokeless firing are also the causes of perfect combustion, if not carried beyond their proper limits. Perfect combustion is smokeless combustion.

There is only a certain quantity of coal in the world. What that quantity is no one knows precisely, but geologists are able to form very reasonable estimates as to the amount in given districts, namely, that assuming the output of coal to go on increasing at the same rate as heretofore, the supply will be exhausted in a little over a century. It therefore behooves all users of coal to limit the amount consumed as far as possible by making use of every possible unit of heat which is given out by the combustion of the coal, and to indulge in no waste that can possibly be avoided.

In reviewing the causes which contribute to the presence of smoke in the atmospheres of our towns, it is easy to divide these into three classes, as follows:

1. Domestic fires.
2. Boiler fires used for making steam.
3. Other furnaces used for industrial purposes.

With very few exceptions the house fires burn anthracite coal, which gives off little or no smoke.

Of the two classes of industrial furnaces, those of steam boilers very much exceed the others in number, and it will be best to confine the discussion to these. The fuel consumed in boiler furnaces is, in almost all cases, obtained from coal. The question, therefore, becomes narrowed down to the combustion of coal in furnaces of boilers, and, in this connection it is necessary to bear in mind that economy must not be lost sight of when considering the question from the point of view of the smoke.

CHEMICAL ACTION TAKING PLACE DURING COMBUSTION.

All fuels, whether liquid or gaseous, as petroleum or solid, are chemically speaking compound substances, made up of certain proportions of the simpler substances or elements. Coal, for instance, is a complex substance, consisting of the elements of hydrogen and oxygen, which exist separately under ordinary conditions as gases; carbon, which is a solid; sulphur, nitrogen and ash. These exist in the coal in various quantities, according to its age and origin. But in a complex substance such as coal, the elementary substances first combine to form what are called compounds, in which the elements always exist in the same unvarying proportions. The smallest particle of a compound substance which can have separate existence is called a molecule, this molecule being made up of atoms of the various substances forming the compound. This will be best made clear by the consideration of a concrete example. Take the case of the formation of water by the combination of hydrogen and oxygen. If there are 18 pounds of water there will be 16 pounds of oxygen and 2 pounds of hydrogen, and the gases always combine in exactly the same ratio, which is fixed and invariable. The atomic weight of hydrogen is said to be 1 and that of oxygen 16. Each element has its own atomic weight. This atomic weight is a relative quantity and denotes the proportions in which this element exists in a compound, or the multiple of such proportions. Thus in case of water two molecules, that is two volumes, of hydrogen combine with one volume or oxygen to form two volumes of water in the form of steam. The molecular weight of hydrogen is said to be 2, the molecular of hydrogen being the smallest particle which can exist as hydrogen; similarly the molecular weight of oxygen is 32, or the weight of two atoms. One molecule of water is made up of two atoms of hydrogen and one atom of oxygen, and the symbolic expression for water is H_2O. The same reasoning applies to the other combinations occurring in the combustion of fuel.

In coal the principal elements are those of the combination of the hydrogen in the coal with the oxygen of the air to form water; the formation of carbon dioxide or carbonic acid by the combination of the carbon, forming carbonic oxide or carbon monoxide, and, lastly, the burning of this carbon monoxide, by taking up another atom of oxygen so as to form carbon dioxide. There is also the combustion of the sulphur in the coal so as to form sulphur dioxide (SO_2), but this is generally neglected. Coke, which is sometimes used for raising steam, is almost entirely composed of carbon, and contains very little gaseous matter. The reactions which take place in the case of the combustion of oils, producing coke-oven gases, are more complex. A molecule of the carbon dioxide formed by the complete combustion of carbon in the air, is made up of one atom of carbon and two atoms of oxygen (CO_2), so that in 44 pounds of the gas there are twelve pounds of carbon and $2 \times 16 = 32$ pounds of oxygen, or in other words, one pound of carbon requires for its combustion $32/12 = 2.66$ pounds of oxygen.

Now, the air of the atmosphere is simply a mechanical mixture of oxygen, which combines with other substances during the process of combustion, and nitrogen gas, which is inert and simply serves to dilute the oxygen. It is in this way useful in checking a too rapid combustion of both combustibles and animal tissues, but, unfortunately, it takes up heat and carries it away to waste.

In 100 volumes of atmospheric air there are 79 volumes of nitrogen and 21 volumes of oxygen, and as equal volumes of nitrogen and oxygen are as 14 is to 16, the proportions by weight are approximately 23 to 77. That is to say, in the air there is a percentage by weight of oxygen of 32, and as one pound of carbon requires for its complete combustion 2.66 pounds of oxygen, this will be equivalent to saying that one pound of carbon requires for its complete combustion $2.66 \times \frac{100}{23} = 11.56$ pounds of air. Similarly one pound of hydrogen requires 36.6 pounds of air.

The different kinds of coal used vary very much in their smoke producing capacity. For instance, anthracite coal used in domestic furnaces is nearly smokeless. On the other hand, steam or soft coal screenings used for steam contains a large amount of volatile matter and is very smoky in combustion. The coke which is left after the distillation of the gaseous matter from coal is practically all carbon and burns with a total absence of smoke. The precise analysis of the several kinds of coal used are given in the following table. Only the constituents with which we are particularly concerned, that is, the hydrogen, oxygen and carbon, are mentioned, the quantities of sulphur being small and unimportant as a heat giving combustible. The actual percentage of sulphur varies from .75 to 1.50 per cent.

Kinds of Fuel	C	H	O	A	Smoke giving qualities
Coke, good............	0.94	..	..	11.28	No smoke
Coal, anthracite......	0.915	0.035	0.026	12.13	Practically no smoke
,, dry bituminous	0.87	0.05	0.04	12.06	Hardly any smoke
,, coking..........	0 85	0.05	0.06	11.73	Very little smoke
,, cannel..........	0 84	0.06	0.08	11.88	Considerable smoke
,, dry long flaming	0.77	0.05	0.15	10.32	Very smoky
,, lignite..........	0.70	0.05	0.20	9.3	Very smoky

In this table are not included the liquid and gaseous fuels nor such occassional fuels as wood and peat. C H and O represent the fractions of a pound of the combustible referred to in one pound of the fuel. The letter A refers to the number of pounds of air required for perfect combustion of one pound of fuel. The quantity of each coal as regards its smoke-producing properties is given in the last column. Of course it must be understood that these are only average values and must not be taken as absolute, especially as regards the coke, of which there are many varieties. It will be noticed that the liability to give off black smoke increases as the hydrogen and oxygen increases and diminishes as the proportion of carbon in the fuel increases. From charcoal and coke, and to a lesser extent anthracite coal, which consists almost entirely of carbon, there is practically no smoke produced under any circumstances. The liquid hydrocarbons are very smoky unless the air supply is carefully attended to. The same is true in a smaller extent in the case of wood and peat, although such smoke as is produced is not so objectionable as that given off from coal. The more gaseous a coal is, that is, the more hydrogen and oxygen it contains, the more liable it is to smoke, and therefore all the more care is required in the adjustment of the air supply. The gaseous fuels, that is to say, the gases containing high percentages of hydrogen, are smokeless.

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*Paper read before the International Union of Steam Engineers, Toronto.

COMBUSTION OF COAL IN BOILER FURNACES.

The chief constituents of coal, so far as heat giving properties are concerned, are, as we have seen, hydrogen, carbon and sulphur. Of these, the sulphur already appears in small quantities and has a low heat-giving value, so that it is neglected in comparison with the other constituents. During the process of combustion the hydrogen of the coal combines with the oxygen of the air to form steam, and heat is given out in the process ; the carbon also combines with the oxygen to form carbon dioxide or carbonic acid ($C O_2$) when the air supply is plentiful and complete combustion takes place, but with an insufficient air supply only partial combustion takes place, and carbonic acid (C O) is formed, with the generation of a smaller quantity of heat. It is therefore important, irrespective of other considerations, that the carbon in the fuel should be burnt so as to produce CO_2, and not C O, the production of the latter being necessarily accompanied by a distinct loss of heat that would otherwise be involved. What actually takes place when coal is burnt in a boiler furnace is not easy to define in a few words. The process of the combustion of coal is a very complex one, and depends to a great extent on the external circumstances accompanying the combustion. When firing takes place, that is, when a fresh supply of coal is thrown on the fire, the fire generally consists of a layer of fuel more or less completely incandescent, this being the carbon of the coal in the form of coke. On the new supply of coal being placed on this glowing mass of fuel, the heat of the latter causes the release of the gaseous constituents of the coal, the hydro-carbons are driven off and burned above the fire with luminous flames. These gases consist of combinations of the hydrogen in the coal with some of the carbon, which goes to make up those hydro-carbons which form a large part of illuminating coal gas, just as heat is absorbed during the process of the generation of steam from water, so that when the gases are driven off from the coal, we have simply a process of evaporation, and the heat is consequently absorbed during the process and a cooling of the furnace is the result. A high temperature is necessary as otherwise the carbon and hydrogen will not combine with the oxygen of the air.

If the temperature of the furnace is sufficiently high and the air supply ample, the hydro-carbon gases will be burned above the furnace with a heat-giving flame, steam and carbon dioxide being formed. If these two conditions are lacking the result will be the formation of smoke. This is a most important point to be noted in connection with smoke production. The combustion can then be divided into two stages—the volatilization and combustion of the hydro-carbons, and, secondly, the combustion of the remaining carbon. The carbon may be completely burnt to CO_2 or only partially to CO. Most of the air which is used for the combustion of the carbon in this second stage is that which is allowed to pass upwards between the furnace bars. If the air supply is ample the carbon will be completely burned to CO_2, which will pass away from the fire to the flues and thence to the chimney. If the air supply from below is insufficient the carbon will only combine to form CO, which will appear at the top of the fire, and if there is a sufficient supply of air the C O will burn. The flame of C O is readily distinguished by its violet-blue tint. If the conditions necessary for the proper combustion of the C O are absent, then the gas will pass off as C O and will result in a corresponding loss of heat. The actual interchanges which take place between the carbon and the oxygen are not very clearly understood, and it is held by some authorities that CO_2 is formed first and takes up a further quantity of carbon as it passes over or through the incandescent fuel, and in this way the CO is formed. This, however, does not greatly matter so far as the present argument is concerned, the main point being that with a sufficient air supply CO_2 is formed, which means that the carbon is perfectly consumed, and that with an insufficient air supply C O will be produced with a corresponding loss of heat and boiler efficiency.

FORMATION OF SMOKE.

The formation or non-formation of smoke is a matter of air supply and temperature. This much may be taken as certain, although the details of the various processes are not clearly determined. The formation of smoke occurs during the volatilization of the hydro-carbon gases. As these come off from the coal, if the air supply is sufficient and at the same time the surrounding temperature is high enough to allow of combustion taking place, the gases will be burnt with a bright flame, steam and carbon dioxide being formed in the process. If, however, the air supply is deficient, or, the air being plentiful, the flames penetrate to portions of the flues which are below the necessary temperature, a recondensation takes place and the carbon becomes separated in a finely divided condition and smoke is formed. Another reason given for the formation of smoke in some cases is that the high temperature of the furnace causes a dissociation of the constituents of the hydro-carbons, which, if the supply of oxygen is insufficient, results in unburnt hydrogen and unconsumed carbon in the form of smoke. If the air supply is ample when this takes place the hydrogen and carbon will be burnt and no smoke will result. The formation of smoke caused by an insufficient air supply is seen in the case of an oil lamp without a chimney. If the wick is turned up a little too high the natural air supply is not sufficient to maintain perfect combustion, but if a glass chimney is placed on the lamp an induced draught will be produced and more oxygen will reach the flame and clear and smokeless combustion will result. Some of the finely divided carbon forming the soot comes off from the coal direct without being first combined with the hydrogen.

In order that the combustion of fuel in a boiler furnace may be perfectly satisfactory from the point of view of the owner and that of the outside public, the combustion must be both economical and smokeless. These two conditions are not necessarily co-existent. A furnace may be highly economical from all points of view, and at the same time may be periodically sending forth a quantity of unburnt carbon in the form of smoke ; or a chimney may be almost smokeless and at the same time be working in a very wasteful manner. It must not be supposed that these two conditions are necessarily opposed to one another, but in some cases they may be, and it is necessary to be careful in discriminating between smokelessness and economy.

The principal conditions which affect us are as follows : 1. The presence of smoke in the gases escaping from a boiler flue is in most cases due to an insufficient air supply either in the neighborhood of the fire doors and above the fuel or at the back of the furnace near the bridge, or to partially burnt gases coming in contact with the cooling surfaces provided by the boiler plates next the water.

2. Economical combustion may be interfered with to a small extent only by the amount of carbon carried away as smoke and by a deposit of carbon on the tubes and plates, which interferes with the proper transmission of heat through them. The chief source of loss of economy in the combustion of coal is due to a too liberal air supply, which, besides the excess of oxygen present, contains much inert nitrogen, which takes up heat and carries it away up the chimney to waste. A too small air supply results in the formation of a quantity of CO, and the carbon burnt in producing it is only partially consumed and yields less than one-third the heat that ought to evolve in complete combustion. Great care is therefore necessary in arranging the air supply so as to give the maximum economy in the combustion combined with a smokeless chimney, besides serving as a carrier of heat to waste ; the excess of air has a cooling effect on the tubes.

If it is important that the air supply should be carefully regulated as to quantity, so also the time of admission should be attended to. After firing, the maximum quantity of oxygen is required for several minutes, until the whole of the hydro-carbons have been driven off and consumed ; after this time the supply should be much reduced. An excessive supply of air after the hydro-carbons have been driven off is not needed, and is a source of waste. During the gasification period, or that immediately after firing, air should be supplied not only underneath and over the bars but also at or near the bridge, so as to completely consume the hydro-carbon gases.

It has been said that the presence of, or freedom from smoke in a boiler depends more than anything else on the quantity of air supplied to the furnace, the time at which this supply is admitted and the place of admission, that is, whether the air is allowed to pass into the furnace above the fire bars, below them, or both above and below at the same time. But not only is the smoke affected by the air supply—the economical working of the boiler depends to a great extent on this also. From the figures given in the above table it will be seen that the number of pounds of air required per pound of coal is somewhere in the neighborhood of 12, and does not vary greatly from this figure. An average value for the minimum weight of air per pound of coal may be taken as 11.5 pounds. This quantity is only that required under the most favorable conditions, that is, when every particle of oxygen of the air supplied is completely consumed, and there is no waste oxygen carrying heat away. These conditions are not possible of attainment in ordinary boiler furnaces, as it is not practicable to bring all the oxygen intimately in contact with the burning fuel so that it may be used.

If the air supply is deficient, either in the general supply or the quantity admitted to some important point of the furnace, the carbon does not take up its proper amount of oxygen, and carbon monoxide is formed instead of carbon dioxide. One pound of carbon, if completely burned to CO_2, gives out by its combustion 14,500 heat units, whereas if partially burned to CO the heat yielded is only 4,500 heat units. It is therefore obvious that for every pound of carbon burned to CO instead of to CO_2 there is a loss of heat equal to about 10,000 heat units. For this reason alone it is obviously necessary for economy that the carbon be fully burnt. This carbon may be free carbon in the incandescent fuel left after the hydro-carbons have been driven off or it may be combined carbon in the gases. If the former the CO goes off as totally invisible gas, and if the latter the imperfect combustion may be accompanied by the evolution of smoke. In either case the remedy is more air, and consequently more oxygen.

The problem with which the engineers are confronted is not altogether a simple one, for if the air supply is deficient CO is found in place of CO_2, and a consequent waste of heat takes place, and this may be accsmpanied by the formation of smoke; whereas if too much air is admitted to the furnace, there is again a loss resulting from the excess oxygen and nitrogen taking up heat and carrying it away from the boiler. There is a point where one loss ends and the other begins as the air supply is increased, and in order to obtain the most economical results with freedom from smoke, this point must be found. There is the further question as to how far a large excess of air is permissible in order to force the boiler and so get a greater table evaporation from a given boiler, but that point need not be considered at present.

The best indication of the quantity of air being used per pound of coal is that given by an analysis of the gases coming away from the furnace. This is not difficult to obtain, samples of the gases being collected at suitable places in the flues, and an analysis made by means of one of the many forms of rough apparatus used for that purpose. On analyzing the products of the combustion they will be found to consist of the following constituent gases:

Carbon dioxide, or carbonic acid (CO_2), from the carbon of the coal and the oxygen of the atmosphere. There is found to be 17 to 5 per cent. of this gas present. These are extreme figures, the more usual ones being from 12 to 7 per cent.

Free oxygen (O). There is usually from 12 to 4 per cent. of this gas.

Carbon monoxide, or carbonic acid (CO). From 2.5 per cent. to none. In very many boilers, working fairly economically, the quantity of this gas which can be detected by the usual means is none.

Unburnt hydro-carbons. These are small in quantity and are not found by the ordinary analysis, but they often exist and must be a source of loss.

The last gas in the flue gases is nitrogen (N), which is found by difference, the sum total of these being subtracted from 100, and the remainder assumed to be wholly of nitrogen. Usually there is 80 per cent. of this gas present.

It is clear then that any excess of air in the flue gases results in heat being carried away to the chimney and so wasted; and on the other hand, a deficiency in the air supply is a cause of a loss on account of the fuel being incompletely burnt and the escape of the carbon monoxide without being burnt.

In conclusion I would ask, what is combustion? It is the chemical combination of the fuel, ordinarily hydrogen and carbon, with oxygen of the air. It is only the quantity of hydrogen in the fuel in excess of what will combine with the oxygen therein which serves any useful pupose. The product of the combustion of such excess of hydrogen and the oxygen of the air gives off 62,032 heat units, and the product is aqueous vapor or water (H_2O). Where carbon unites with only one part of oxygen the product is carbon monoxide (CO). When carbon unites with two parts of oxygen the product is corbon droxite (CO_2). Carbon monoxide givesoff 4,400 heat units. Carbon dioxide gives off 14,500 heat units, and twelve pounds of air are required to furnish the oxygen to thoroughly consume one pound of carbon, although twice that amount is ordinarily used in steam plants. The air contains by volume four parts of nitrogen and one part of oxygen, but the nitrogen is useless for combustion purposes. The oxygen of the air, however, will not unite with the carbon in the fuel until the air is considerably raised in temperature. In ordinary combination systems, cold air is introduced to the fire to supply this necessary oxygen. When air is thus introduced cold to the burning coal there is a great expenditure of energy of the fuel in heating the air to the temperature necessary to free its oxygen. In a steam plant, therefore, tons of air must be raised each day to a high temperature before it can join in the useful work of combustion. It is therefore clear that every degree of heat added to the air before it is supplied to the furnace is so much energy saved to the fuel, and knowing the amount of heat which is evolved by the combustion of a fuel it is quite possible for us to calculate the amount of energy it will give. Thus carbon with 14,500 B.T.U. per pound would give for each pound consumed 11,204,000 foot pounds of energy. An expenditure of energy at the rate of 33,000 foot pounds per minute is called a horse power and the work done in one hour will therefore be 1,980,000 units, which is called a horse power hour. It will be seen, therefore, that the combustion of one pound of carbon gives energy every equivalent to about 56 horse power hour. From this statement it will be easy to realize the enormous amount of latent energy which is stored up in fuel. In practice the whole of this enery can never be realized.

The sources of loss which render it impossible to convey all of the heat into the steam are many, namely:

1. The furnace, gases must escape at a sufficiently high temperature to create a draught, and as each pound of fuel requires about 25 pounds of air for its combustion, this must always be very great. Assuming the temperature to be 400 F., which will be much lower than usual, and the specific heat of the gases to average 25, this will amount to $25 \times 400 \times 25 = 250,000$ units for each pound of coal consumed, or say roughly 20 per cent.
2. Loss of heat through the walls.
3. Loss by ashes falling with carbon through the grates.
4. Evaporation of water in the fuel is often very considerable.
5. Loss due to formation of smoke and inherent gases escaping up the flue with the products of combustion.

[Mr. Bly exhibited several interesting charts showing the quantity of smoke emanating from different chimneys with hand firing and with smoke consumers of various kinds.—The Editor.]

TORONTO ENGINEERS' DINNER.

The engineers of Toronto No. 1, C.A.S.E., and their friends assembled at the Walker House on Thanksgiving eve, November 16th, on the occasion of the eighteenth annual banquet of the Association. About 150 persons were present and a very pleasant evening was spent.

The president, Mr. W. L. Outhwaite, was presiding officer, while to his left sat Mr. Charles Moseley, Chairman of the Dinner Committee. Those around the head table included Mr. Thomas Crawford, M.P.P., Dr. Pakenham and W.S. Kirkland, of the Technical School, and Mr. J.J. Mann, of the Canadian Heine Boiler Company. The Hamilton Association was represented by Messrs. R. C. Pettigrew, Joseph Ironsides and F. J. Sculthorpe.

The chairman read letters of regret from His Worship Mayor Urquhart and Mr. E. F. Clarke, M.P.

The room was appropriately decorated, prominence being given to the national flag. A bounteous repast was partaken of, and following the removal of the cloth, metaphorically speaking, came the toasts, which were intermingled with music and song.

The National Anthem was sung in honor of "The King and Royal Family," and "The Maple Leaf" in response to "Canada, Our Home." Coupled with the toast of "Toronto, Our City" were the names of Mr. J. M. Sinclair, manager of the Eureka Mineral Wool Company, and Mr. W. P. Bull. Mr. Thos. Crawford, M.P.P., the engineer's friend, responded to the "Legislature of Ontario" and predicted that in the near future the Government would grant the legislation which had been asked for by engineers, which was not only in the interest of the association, but was necessary for the proper protection of life and property.

Mr. J. J. Main was the first to respond to "The Manufacturers" toast. He was in a happy mood and caused many rounds of laughter. Becoming more serious, he deplored the many boiler explosions which had occurred and which in his opinion could have been avoided if competent engineers had been in charge. As a manufacturer of boilers, he declared all explosions to be due to carelessness, ignorance or neglect. Mr. E. E. Teale, manager of the Aluminum Cork & Seal Company, replied to the same toast in a very able speech. He commended the engineers for their efforts to secure a license law and hoped they would be successful. The United States laws were very stringent and placed the responsibility of an explosion on the manufacturer as well as the engineer, the manufacturer being fined and the engineer dismissed. The relationship which should exist between the manufacturer and the engineer was too often not considered. How many manufacturers enter the engine room, he asked, and how many understand the work of the engineer? It required a great deal of study to be a good engineer.

Dr. Pakenham and Mr. W. S. Kirkland responded to "Education." The latter pointed out the relation between education and the advance of science, particularly in respect to the improvements to the steam engine. He thought technical education was yet in its infancy, and regretted the lack of equipment at the Toronto Technical School.

Messrs. F. J. Sculthorpe, president, H. E. Terry and A. M. Wickens responded to the toast of "The Executive Council," R. C. Pettgirew and J. Ironsides, of Humilton to "Sister Societies," T. S. Young, of the ELECTRICAL NEWS, to the "Mechanical Press," and Messrs. Fletcher and Day to "Our Guests," Mr. Ironsides then proposed the toast of "Toronto No. 1," to which Messrs. W. L. Outhwaite and Chas. Moseley responded. The singing of "God Save the King" terminated the evenings' proceedings.

The musical programme was furnished by Messrs. McDonald, Wallace, Day, Wilson, Coward and Bannister, Mr. Howard G. Fletcher officiating as accompanist in a very acceptable manner.

The Dinner Committee was composed of Messrs. W. Outhwaite, president; Cearles Moseley, chairman; W. C. McGhie, secretary-treasurer; Alex. Storer, A. J. Butcher, H. E. Terry, W. Inglis, G. C. Mooring, J. M. Marr and J. M. Dixon.

TAMPERING WITH METERS.

Under power conferred by their charter the Montreal Light, Heat & Power Company have within a period of three months recently collected upwards of $2,000 in fines from customers and others who have been convicted of having tampered with the Company's meters.

The Company's inspectors keep a close watch on customers' premises and the persons found guilty of stealing current are only too glad to escape exposure and imprisonment by paying their fines promptly. The Company impose a fine of $10 for each offence.

ALUMINO THERMICS.

A lecture describing the new process of Alumino Thermics was given by the inventor, Dr. Hans Goldschmidt, of Essen-Ruhr, Germany, at McGill University, Montreal, on October 7th last, and was subsequently repeated by Mr. William Abbott before the Canadian Railway Club in that city. This process consists in mixing aluminum in certain proportions with a chemical compound containing oxygen, so called "oxide," in order to obtain a heating compound known as Thermit. This material contains most remarkable and important properties, of which we might mention its high combustion temperature, about equal to that of the electric arc, and the speed of the reaction. It is claimed that by no other means has it hitherto been possible to produce liquid steel in so speedy and simple a manner. Thermit promises to be found very valuable for many purposes, including metallurgical applications, hard soldering, pipe and rail welding, etc. Mr. William Abbott, 344 St. James street, Montreal, is the sole agent for Canada.

PUBLICATIONS.

The I. P. Morris Company, of Philadelphia, Pa., have issued an attractive illustrated bulletin relating to their heavy water turbine and centrifugal pump machinery and describing the more important installations made by them.

Two booklets recently issued by the Canadian Westinghouse Company are of an interesting character. One refers to Westinghouse Type C motors for alternating current service, and the other to Type S motors for direct current circuits.

Messrs. Whittaker & Company, Paternoster Square, London, E. C., England, have published "The Telephone Service: Its Past, its Present, and its Future," by Herbert L. Webb, M.I.E.E. The auther describes in plain language the general features of a modern telephone system and the principles which govern the cost of production of a telephone service. The retail price is one shilling.

The Chase-Shawmutt Company, of Newburyport, Mass., have issued Bulletin No. 22 covering "Shawmutt" National Electric Code Standard enclosed fuses, which are designed and made to conform to the latest specifications of the Underwriters National Board, whereby the product of the different manufacturers of this material must be interchangeable—that is to say, the fuses of a given class must be so constructed that it will be possible to use them in any other manufacturers' cut-outs made to conform to the National Electrical Code Standard. This company have been working on this material for a long time, and claim to be the first manufacturers to place them on the market, with a complete line in stock for immediate delivery. They were aided in their efforts from the fact that in selecting dimensions for the National Electrical Code Standard fuses, two of the standards selected conform to their regular line of material, enabling them to save their complete line of porcelains in both the thirty and sixty ampere, two hundred and fifty volt sizes.

Mention of the Twentieth Anniversary Number of the Street Railway Journal, of New York, was omitted from our November issue. The publishers are to be congratulated in producing what is the largest number ever published of any technical or trade paper. There are 180 pages of reading matter and 360 pages of advertisements, in addition to 18 pages of a digest in German and French of the issues of September 10, 17 and 24 and October 1 and 8. It contains a series of excellent articles on the achievements of the early workers who have made the electric railway what it is to-day, including the following: "The Difficulties which Confronted the Early Engineers," by W. E. Baker; "The Development of the Railway Switch," by W. E. Harrington; "The Development of the Interurban Electric Railway," by Henry A. Everett; "The Development of Street Railway Accounting During the Past Twenty years," by C. Nesbitt Duffy; The Development of Railway Motor Design," by S. T. Dodd; "The Evolution of the Modern Power Station," by J. G. White, and "The Development of Street Railway Track Construction During the Past Twenty Years," by W. B. Reed.

SPARKS.

The village of Fort Saskatchewan, N. W. T., will likely purchase the old Edmonton electric light plant for $7,000.

Messrs. Wickett & Craig, leather manufacturers, Toronto, have installed an electric plant for lighting their premises.

The Water, Light and Telephone Commissioners of Fort William, Ont., will ask the City Council for $22,000 for telephone extensions and $5,500 for electric light extensions.

Messrs. James Finlay and F. J. Weeks, of Marysville, B.C., have given notice that they will apply for the incorporation of a company to construct and operate a tramway from Sullivan Hill, South-East Kootenay, to the North Star branch of the Crow's Nest Pass Railway.

At a recent meeting of the Fire, Water and Light Committee of Orillia, Ont., the flat rate for electric current was reduced to 20 cents per light per month, and the meter rate to 8 cents per 1,000 watts, these prices being net. The power rate was also reduced to the old rate of $16 per horse power.

Acting upon the reports submitted by Mr. J. M. Campbell, the City Council of Kingston, Ont., have decided to submit a by-law to the ratepayers to raise $150,000 for improvements and extensions to the present electric and gas plants. Of this amount it is proposed to expend $56,000 on the electric plant.

Mr. K. L. Aitken, chief engineer of the Electrical Supervision Society, Toronto, recently gave an illustrated address on "The Toronto-Niagara Power Development" to the students and friends of the International Correspondence School. The lecture was given in the large assembly hall in the Temple Building and proved to be very interesting.

The Ingersoll Electric Light & Power Company, Ingersoll, Ont., have recently made important additions to their plant, including two direct current Westinghouse generators and a 250 h. p. Goldie & McCulloch Wheelock engine. Their business is steadily increasing and a further addition to their plant will likely be necessary in the near future.

It is announced that Montreal capitalists, including Messrs. H. S. Holt, Charles R. Hosmer and F. W. Thompson, have purchased the Kakabeka Falls, situated about twelve miles from Fort William, Ont. The falls are 125 feet high and arrangements are said to have been made for the immediate construction of a plant that will develop 30,000 horse power.

The New Brunswick Electrical Power Company, recently incorporated, have had surveys made with the object of developing the power of the Aroostook Falls, on the Aroostook River, a tributary of the St. John river. A minimum of 4,000 horse power can be developed at a comparatively moderate expenditure of capital, and it is proposed to utilize the energy to operate an electric railroad to be built from Presque Isle to Washburn and Perham, and for furnishing light and power.

The Canadian Westinghouse Company held their annual conference of managers and engineers in Hamilton during the first three days of December, which closed with a complimentary banquet at the Royal Hotel, given by Mr. Paul J. Myler, the local manager. Besides the Hamilton officials the following managers were present: Messrs. F. H. Taylor, Pittsburg; C. F. Scott, Pittsburg; J. H. Farley, Pittsburg; H. D. Bayne, Montreal; T. F. Dryden, Toronto; W. E. Skinner, Winnipeg; H. D. Scribner, Vancouver, B. C.

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SPARKS.

The City Council of St. John, N. B., took over the Carleton electric light plant on December 1st.

The new electric light station at Raymond, Man., has been completed. Over 750 lights are now installed in the town.

Messrs. R. T. Walsh & Son have their plant almost completed for supplying electric light in the village of Ormstown, Que.

The Council of Nelson B.C., have acquired the electric railway of that place and will operate it under municipal control.

The E. Smith Basket & Veneer Company, of Leamington, Ont., have installed an electric light plant for lighting their factory.

The Town Council of Moncton, B. C., have decided to take steps at once to increase the capacity of the electric light plant.

The Singer Sewing Machine Company are building a large power house in connection with their new factory at St. Johns, Que.

The Governor-in-Council has approved of the by-law to raise $15,000 for the extension of the electric light plant at Niagara Falls, Ont.

The Maritime Engineering Company, of Moncton, N. B., are building a 100 horse power engine for the Arcadia Sugar Refinery Company.

The Cunningham Electric Company, of Edmonton, N.W.T., has been dissolved and the business will hereafter be conducted by Mr. H. A. Campbell.

The two new 5,000 Westinghouse generators installed in the Hamilton Cataract Power Company's station at DeCew Falls were put in operation last month.

It is understood that the W. A. Murray Company, of Toronto, are considering the installation of additional engines for their lighting and power plant in their departmental store.

It is understood that G. M. Miller & Company, architects, of Toronto, are preparing the plans for the new power house to be built at Chelsea Green, near London, Ont., by the Southwestern Traction Company.

Mr. C. H. Keefer, C. E., of Ottawa, has recommended the construction of a new waterworks dam for the town of Peterboro, Ont. A new power house may also be built on the east side of the Otonabee river, for municipal lighting.

Three hundred and thirty-three thousand lamps are inspected yearly by the meter inspectors in the employ of the Montreal Light, Heat and Power Company. A detailed record is kept of all lamps to which current is supplied by the company.

The DeLano Osborne Engineering Company, consulting electrical and mechanical engineers, of Toronto and Montreal, have been commissioned by the City of Charlottetown, P.E.I., to prepare plans and estimates for a civic lighting and power plant.

The Water Committee of the Montreal City Council have instructed Superintendent Janin to ask for tenders for a twelve million gallon steam pump, a twelve million gallon electric pump and a five million gallon turbine pump. Only one of the larger pumps will be purchased.

The new water power plant of the Meaford Electric Light and Power Company, Meaford, Ont., is expected to be in operation before the end of the current year. A new generator with all the necessary equipment has been installed. Mr. David Robinson will have charge of the plant.

A sum has been agreed upon as the price at which the City Council of St. Thomas, Ont., will acquire the plants of the St. Thomas Gas & Electric Light Company, the figure being $196,366.38. By this agreement the City is saved the cost of arbitration proceedings, which had previously been agreed upon. The valuation was made by Mr. James T. Lynn, of Detroit.

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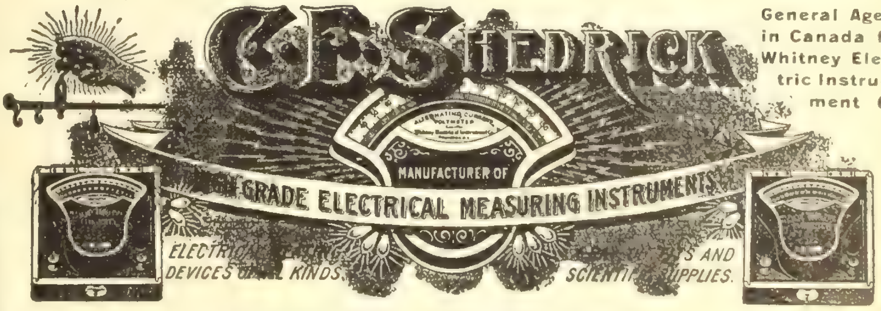

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TRADE NOTES.

From the general interest shown in the subject of thawing water pipes by electricity, it is believed that a great many central stations will provide the equipment for doing this work this winter. Sufficient has been done in this line to indicate the possibility of large returns. Some of the larger companies in the United States last winter took in various sums, in some instances as high as $12,000 for the season's receipts for this work, so that it is quite evident that a good field exists for increasing the revenue of almost every central station in Canada. The Pittsburg Transformer Company have placed on the market a pipe thawing outfit which is fully described and illustrated in their December bulletin just received by us.

Arrangements have been concluded whereby the marketing of the several well known products of the Crocker-Wheeler Company and Brown, Boveri & Cie, in the Dominion of Canada, will be looked after by the selling organization of the Packard Electric Company, Limited, of St. Catharines, Montreal and Winnipeg. The Crocker-Wheeler Company are manufacturers and electrical engineers, with their works and main offices located at Ampere, N. J. Their line of manufacture includes electric generators and motors for every industrial, lighting and power purpose. They are licensees for the North American Continent of Brown, Boveri & Cie, of Baden, Switzerland, celebrated designers and manufacturers of alternating current apparatus, whose efforts in this field have brought the alternating current machine to a point of standardization. The reputation for excellence earned by Crocker-Wheeler apparatus during the past fifteen years has spread beyond the United States, and it is to better serve their increasing trade in Canada that this arrangement has been made.

The official tests of the large electric locomotive built by the General Electric Company for the New York Central Railroad took place on November 12. The entire morning was spent running with from three to nine cars, 75 miles an hour being the maximum speed attained, but there is little doubt in the minds of officials who witnessed the tests that a speed of over 90 miles an hour can be made. The locomotive tested is the first built of forty ordered by the New York Central Railway for its New York terminal.

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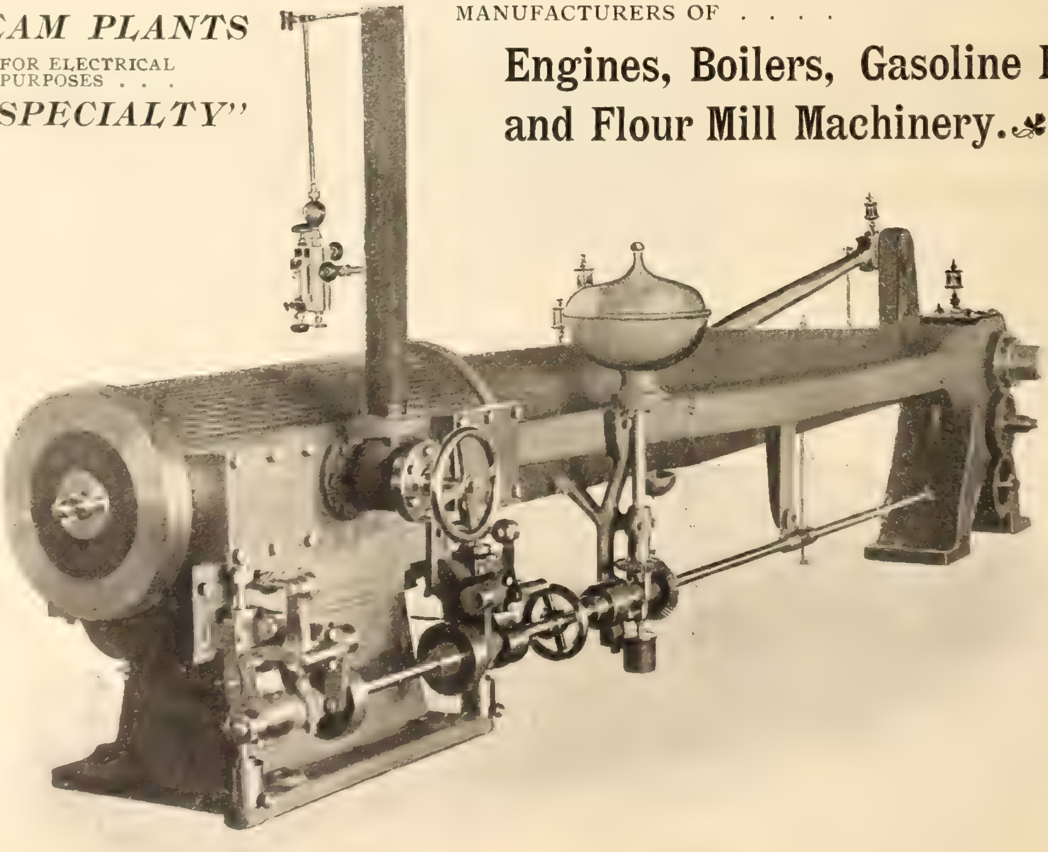

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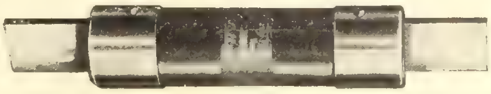

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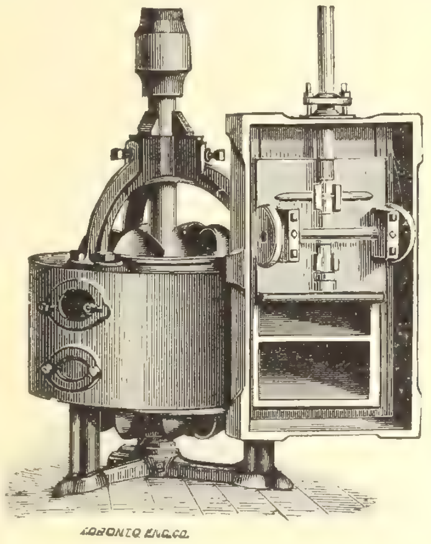
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SPARKS.

The Jones & Moore Electric Company, manufacturers of electrical apparatus, recently moved into their new building at 296 Adelaide street west, Toronto. The building is 60 x 200 feet and three stories high, and is equipped with modern machinery for the manufacture of dynamos, motors and supplies.

Mr. J. T. Kissack has assumed control of the plant of the Paisley Electric Light Company, of Paisley, Ont., and has announced the following changes in the schedule of rates: In residences where less than four lights are installed 1¼c. per light instead of 1c, and all commercial lights in use after 12 o'clock midnight to be charged for at the rate of 1½c. per light.

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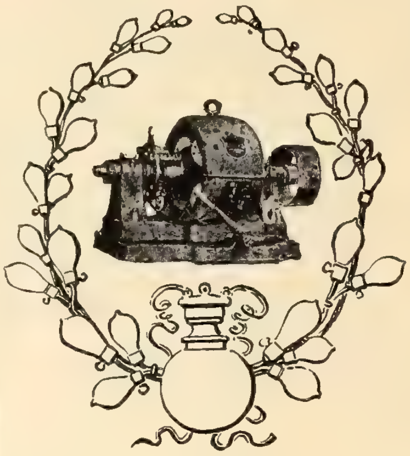

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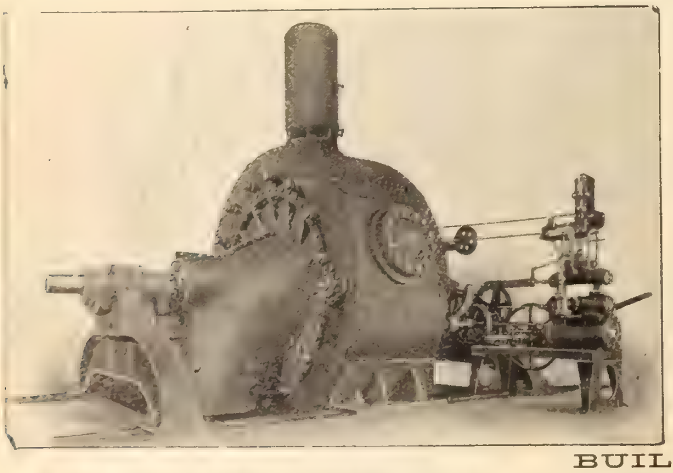

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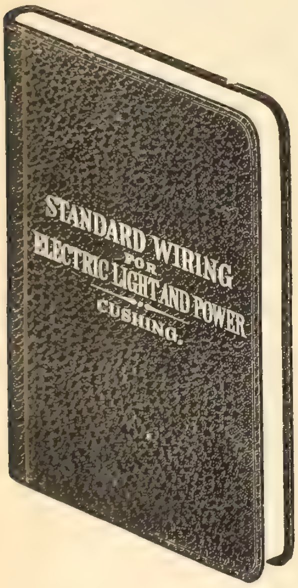

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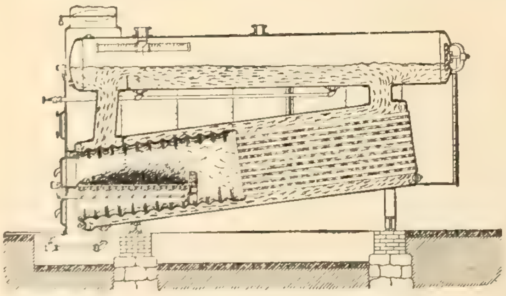

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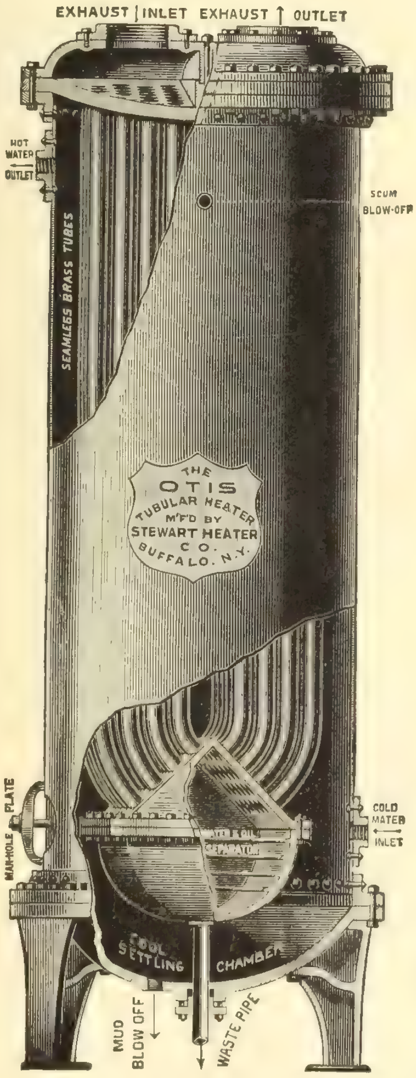

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SPARKS.

The Cranbrook Electric Light Company, of Cranbrook, B.C., have found it necessary to install another dynamo.

The work of remodelling the electric light and power p'ant of the Alexandra Palace, University Avenue, Toronto, has been placed in the hands of the Electrical Supervision Society. A new generator will probably be installed and other material changes made. Manufacturers of switchboard supplies, incandescent lamps, and other needed apparatus are requested to communicate with the Engineers.

The Saugeen Electric Light Company, of Southampton, Ont., have lately replaced their old generator by a new three-phase alternating current machine of 200 k. w. This was done in order to overcome the loss in transmission from the power house to the town, a distance of three miles. The voltage was raised from 2,000 to 6,600 volts, and reduced by a step-down transformer of 90 k. w. at the distributing centre. This plant also supplies the lighting for Port E'gin, six miles distant, a 60 k. w. step-down transformer being used. The equipment was installed by the Canadian General Electric Company.

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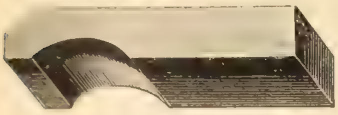

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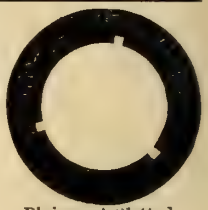

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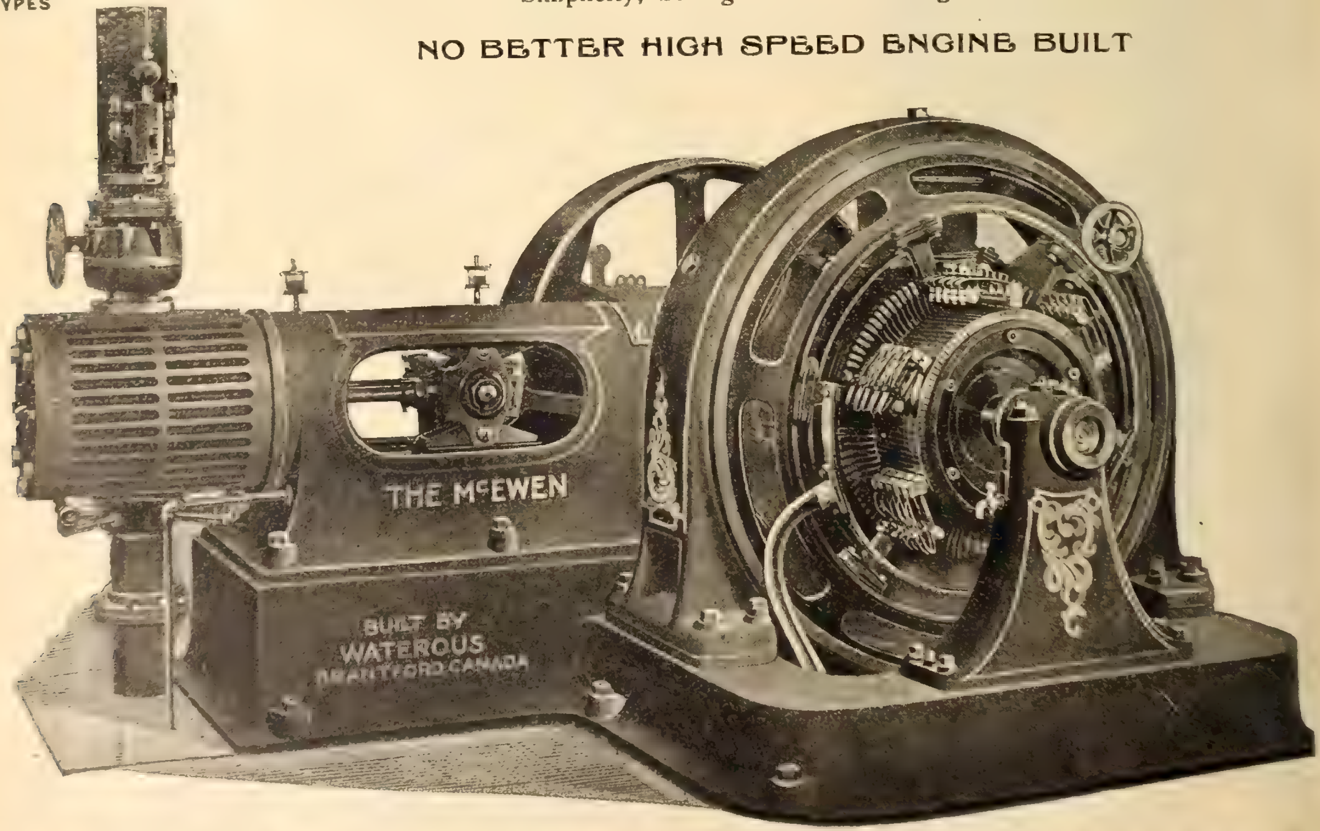

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To the Cooper Hewitt Electric Company, for "Vapor lamps for photo-engraving."—Group 15.

To the Pittsburg Meter Company, for "Water and gas meters."—Group 64.

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To the Bryant Electric Company, for "Electric light fittings."—Group 69.

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